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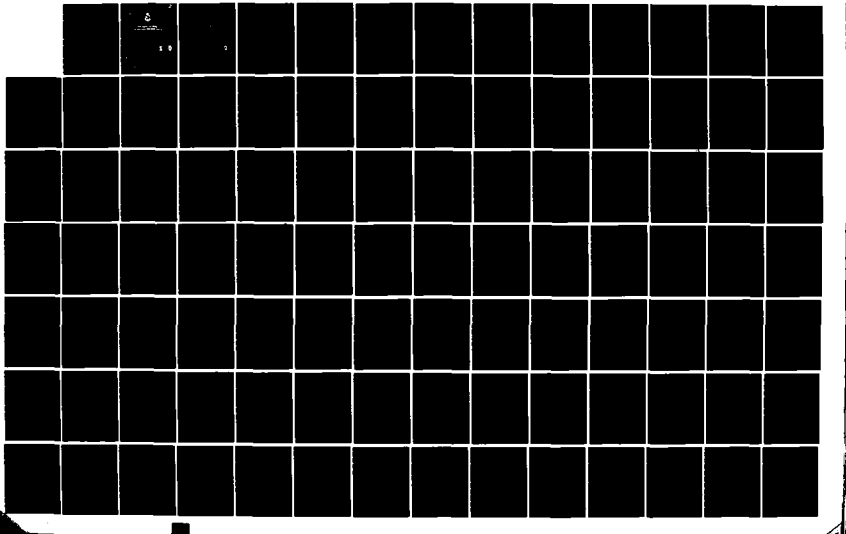

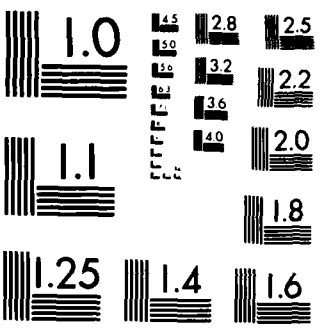

MICROCOPY RESOLUTION TEST CHART
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USER MANUAL FOR IMAGER: THE DREO IMAGE PROCESSING SYSTEM

by

Claude Brochu

and

Roy Ball, Ken Lim, Soren Sorensen

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TECHNICAL NOTE 82-16

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September 1983
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USER MANUAL FOR IMAGER: THE DREO IMAGE PROCESSING SYSTEM

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ABSTRACT

The purpose of this document is to assist the user of the DREO Image Processing System in the processing of digital images. The system, which includes a minicomputer and a NORPAK Image Processor, is accessed via an easy to use menu structure. The manual explains the general purpose of the functions accessed through the menus as well as the subtleties of their uses.

RÉSUMÉ

Le but de ce document est d'assister l'usager du système de traitement d'images du CRDO dans le traitement numérique d'images multispectrales. Le système, composé d'un miniordinateur et d'un système d'affichage et de traitement vidéo de NORPAK, peut être facilement utilisé. L'usagé est guidé vers l'opération à accomplir au moyen d'une hiérarchie de menus. Ce manuel explique les buts généraux et le fonctionnement des différentes opérations choisies par les menus.

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IMAGER USER'S MANUAL

SECTION 1: SCOPE

This document is designed to assist the user of the IMAGER system in processing digital images. The system is accessed via an easy to use menu structure. The manual explains the general purpose of the functions accessed through the menus and explains the subtleties of their use. Explanations of the IMAGER error diagnostics appear in alphabetical order in Appendix A.

The system can accept digital images that have been stored on magnetic tape using a variety of formats. An image, once in the system, will consist of a matrix of pixel intensities (from 0 to 255) 640x480 in size. This may be only a sub-image of the external image on magnetic tape.

SECTION 2: APPLICABLE DOCUMENTS

REQUIREMENT SPECIFICATIONS FOR IMAGER THE DREO IMAGE PROCESSING SYSTEM	DREO TN 82-14
DESIGN SPECIFICATIONS FOR IMAGER THE DREO IMAGE PROCESSING SYSTEM	DREO TN 82-15
IMAGER System Manual	Internal report

SECTION 3: GENERAL SYSTEM DESCRIPTION

3.1 INTRODUCTION

The intent of this manual is to give the user of the DREO IMAGE PROCESSING SYSTEM - IMAGER, sufficient information to allow him to use the system and to understand the operations. This programming package makes it possible to move images around between peripheral supports such as disk,tape and NORPAK refresh buffers and includes some image enhancements and manipulations.

Multispectral image analysis techniques have been implemented. They are image ratioing, Gaussian classification, intensity correlation and algebraic combination of images. Also, monospectral techniques for histogram equalization, level slicing, zooming and pixel intensity dump have been developed.

3.2 IMAGE STORAGE MEDIUM AND FORMAT

3.2.1 Introduction

The primary storage medium for image data is magnetic tape. The images are routed to disk storage and may be copied to the NORPAK refresh buffers and displayed on the colour TV monitor. The disk files are an important storage medium that allows a quick and simple means of manipulating and selecting image data.

The IMAGER system presently has the capability of retrieving images in two formats from tape: the so called ERIM format and IMAGER's standard format. It can also retrieve from the refresh buffers images created by some other computer programs and route them to a disk file.

Other sources of image data on disk are the results of image processing techniques applied to images such as classification or ratio, and the algebraic combination of images.

A few more files are used to store the processing results: the intensity correlation information, the log of disk image file creation and the temporary image files created by the algebraic combination of images and the classification packages.

The names of these files are filename.CO, IMAGER.LO, $ALGC and $CLASS respectively. The last two files are short lived but they can be renamed to become standard image files by the operator.

3.2.2 ERIM Format

In the ERIM format, an image is stored on magnetic tape in band interleave fashion in one large file. Each line of imagery is stored using 5 or 12 records with each one containing the data for one band only. The first record on tape is a header record which has information about the date, time, some flight parameters and band values. The last line of data is followed by two end of file (EOF) marks.

3.2.3 Standard Format

In the standard format, one band of imagery is stored in a file either on disk or on tape. The image is a portion of the complete image found on ERIM tape. This portion has the exact size of a memory bank in the frame buffer of the NORPAK RGP-305[illegible] Image Processor, that is 640 pixels per line for 480 lines. Th size of an image in standard format is fixed. The first record of each file is a header record which contains an image file sequence number, date and time of data creation, a source data tape identification and a user comment section. For ERIM data, the comment comes from the ERIM tape header, but for other type of imagery the comment is entered by the operator. A total of 16 standard format files (by design) may be stored on a disk pack and more than 30 files can be stored on magnetic tape. These 16 image files saved on disk are named DIM01 to DIM16.

3.2.4 Refresh Buffer Header Files

Every time an image file is copied to a refresh buffer, the file header is also copied into what is called a refresh buffer header file. The purpose of this is to help the operator remember which image is stored in a particular memory bank. These files are deleted each time the NORPAK processor is initialized by operator request at the start of the IMAGER program. These files are named DIM17 to DIM20 for memory banks 0 to 3.

3.2.5 LOG file

The LOG file IMAGER.LO contains information on files created by IMAGER. Every image file is assigned a unique sequence number and the log contains enough information to specify when and where the data originated and what type of operation if any, was done on it, or which images files were used to produce it.

The log of an image file resulting from an operation on other images contains the sequence number of those images. This log, along with a user comment, gives the history of the newly created image file. The LOG file contains the log information of all the images. Some examples of information contained in the LOG file are shown in paragraph 5.4.5 below.

3.2.6 Message File

Because of the quantity of messages the IMAGER program needs for its operation, namely the menus, queries and error messages, too much computer memory was needed to store them. It became very difficult to expand the IMAGER system. To spare memory for program and data, a message file system was designed to contain most of the text and output FORMATs specifications required. This file is named IMAGER.ER.

3.3 IMAGER SYSTEM OVERVIEW

The IMAGER system is completely interactive. From a menu displayed on the console screen, the user selects which particular set of operations or actions he wishes to be performed. He answers queries from IMAGER or picks further selections from sub-menus.

The messages on the console screen are self explanatory. Operator errors are handled by the system by repeating the question. When errors are encountered while transferring images from one medium to another, the system aborts the operation and recalls the particular menu or sub-menu to the screen for a new start. In addition, some operations and all device errors are reported to the line printer. The tape drive status and certain positions of the tape are also indicated such as beginning of tape (BOT), end of data on tape (2 EOF encountered) and end of tape (EOT). These will inform the operator of unusual situations so that he can deal with any problem arising from them.

```
EXECUTING

TRANSFER    DISK file  to  TAPE file

    1          10             3
    2           8             4
    3           5             5
```

After each successful completion of a data transfer the following message is printed on line printer:

```
XFER COMPLETE - DISK FILE NO. nn TO TAPE FILE NO. nn
```

5.3.4 Disk to Refresh (DR)

The command DR is used to transfer images from disk files to the NORPAK frame buffer. A maximum of 4 transfers can be done at any one time to the 4 banks of memory residing in the refresh buffer.

The user is asked to enter the source disk file numbers and the destination refresh banks where the images will be stored. The following appears on the console:

```
- - - DISK TO REFRESH - - -

TRANSFER No. nn
- INPUT SOURCE DISK FILE (0 FOR END)  > _

- INPUT DESTINATION REFRESH BANK NO. (0 TO 3)  > _
```

After the specifications for a transfer are given, the following informative text and request appear on the console.

```
FILE TRANSFER NO. n
SOURCE DISK FILE NO. n
DESTINATION REFRESH BANK NO.  n
IS THIS CORRECT? (Y OR N OR X FOR EXIT) _
```

A Y answer restarts another sequence for the next image transfer to refresh buffer. A maximum of 4 transfers can be done at one particular instance. An N answer restarts the sequence for this transfer. An X aborts the operation and the Route Image sub-menu is again displayed on the console screen.

The RDOS command used to initialize a tape can be sent only when IMAGER is not running.

```
R            (prompt)
INIT/F  MT0
R
```

If the mounted tape has been verified as a standard format tape the program requests the tape number,

```
- ENTER TAPE No. ____
```

and compares it with the value found in the label.

If the number is correct, the tape is moved to the end of the last file. During the search for the EOF the following message is sent to the console.

```
** POSITIONING TAPE **
```

When the tape has been positioned the number of files on the tape is displayed for information purposes.

```
NO . OF FILES ON TAPE IS nn
```

The user is requested to give the disk file numbers he wishes to transfer to tape. A maximum of 16 file transfers are allowed with no duplication of disk files.

```
INPUT ONE DISK FILE NO. TO TRANSFER
(0 FOR END)
```

After all desired data transfers have been specified to the satisfaction of the operator, the transfers are started by entering a zero when IMAGER requests the disk file number. When 16 transfers have been specified the start is automatic.

The following table title is output to the console and before each data transfer the table is filled with the relevant information:

After each successful completion of a data transfer, the message

```
TRANSFER No.  nn  ---  TAPE FILE  nn SENT TO DISK  FILE   nn
```

is printed on the line printer. When all data transfers are completed, the console displays

```
PAUSE '          ***  ALL TRANSFER TERMINATED ***
```

During data transfer, any disk or tape errors are fatal. They will cause the current disk file to be deleted and all further data transfers aborted. Error messages will be sent to the line printer and control will return to the Route Image sub-menu.

5.3.3 Disk to Tape (DT)

The DT command is used to transfer images from disk files to standard format tapes. The user is asked to mount the tape.

```
- - - DISK TO TAPE - - -

- HIT 'CR' WHEN TAPE IS MOUNTED
```

If this tape is a new tape (a tape with no image data, but initialized with two EOF marks at its beginning), the system must write a standard tape header label to the tape. A tape number is requested as follows:

```
--- THIS IS A NEW TAPE

PLEASE INPUT A 4 DIGIT TAPE NUMBER > ____
```

It should be noted that the program expects a new tape to be fully INITIALIZED with RDOS before calling IMAGER, otherwise there will be a tape time out and the program will stop. For clarity, an initialized tape is defined as a tape with two EOF marks recorded at its beginning.

The user can continue using the tape or abort the operation by purposely entering an incorrect tape number at the second request for a tape number. When a standard tape is mounted, a sequence of requests is sent to the operator asking for the source tape, the file number and destination disk file number. A standard format file on tape as well as on disk has a fixed image size of 480 lines containing 640 pixels each. The following appears on the console:

```
TRANSFER n  -  INPUT TAPE SOURCE FILE No.    >
               INPUT DESTINATION DISK FILE No. (1-16) > _
```

After the specifications for a transfer are given, this informative text appears on console followed by an action request.

```
TAPE FILE   nn   TRANSFER TO DISK FILE  nn
IS THIS CORRECT?  (Y or N or X) > _
```

A Y answer restarts another sequence for the next file transfer. A maximum of 16 file transfers can be done at one particular instance. An N answer restarts the sequence for this file transfer. An X aborts the file transfer operation and the Route Image sub-menu is displayed again.

After the desired data transfers have been specified to the satisfaction of the operator, the transfers are started by entering a zero when IMAGER requests the tape file no.

```
TRANSFER nn - INPUT TAPE SOURCE FILE NO  . (0 for END) > 0
```

When 16 transfers have been specified, the start is automatic.

The following table is output to the console and before each data transfer the table is filled with the requested information.

```
EXECUTING

TRANSFER   TAPE file  to  DISK file

    1          3             5
    2          6             2
    3          7             4
```

After all desired data transfers have been specified to the satisfaction of the operator, the transfers are started by entering zero when IMAGER requests the Band No. A maximum of 16 transfers can be specified at any one time. The time of ERIM data creation is also requested before starting the transfers.

```
- INPUT BAND NO. (0 FOR END)   >   0

- Enter Time of  ERIM  Data Creation ( HR,MIN )  >
```

During each data transfer the following message

```
**     EXECUTING TRANSFER NO. n     **
```

is displayed on the console. Upon successful completion of a data transfer, the message

```
nnn RECORDS OF BAND nn STARTING AT LINE nnnn
HAVE BEEN TRANSFERRED FROM ERIM TAPE TO DISK FILE NO. nn
```

is displayed on the console and printed on the line printer.

When all data transfers are completed, the Route Image sub-menu is displayed on the console.

5.3.2.3 Standard Format (ST)

When the standard format is selected, the first record on tape is read as a check for the standard format tape header. If the tape is standard format, the tape number is requested

```
---  READ STANDARD TAPE  ---

-  ENTER TAPE NO. ____
```

and compared with the value found in the header. If the tape numbers do not match, the following message is sent to the console.

```
---  TAPE No. NOT MATCHED -- MOUNTED TAPE IS nnnn

-  ENTER TAPE No. ____
```

image on tape. During th s operation, the following message is displayed on the console.

```
--- ERIM FORMAT ---

GETTING TAPE CHARACTERISTICS
PLEASE WAIT
```

When this is completed, the content of the ERIM header is printed on line printer for information and the operator is asked for the transfer specifications (i.e. band no, start no., line increment, and disk file number). The following queries are sent to the console:

```
FILE TRANSFER NO.      n

   - INPUT BAND NO. (0 FOR END)    >
   - INPUT START LINE NO.          >
   - INPUT LINE INCREMENT          >


FILE TRANSFER NO.  n

   - INPUT DESTINATION DISK FILE NO. (1-16)    >
```

If the destination disk file exists or is write protected this query is sent:

```
 - DISK FILE   n IS WRITE PROTECTED
 DO YOU WISH TO OVERWRITE? (Y or N)  > _
```

After the specifications for a transfer are given, the following informative text and request appears on the console:

```
FILE TRANSFER NO. n
BAND NO.  n  START LINE NO.  n
AND LINE INCREMENT   n    FROM TAPE
TO DISK FILE NO.   n
IS THIS CORRECT?   (Y or N or X)  >   -
```

A Y answer restarts another sequence for the next file transfer. A maximum of 16 file transfers can be done at one particular instance. An N answer restarts the sequence for this file transfer. An X aborts the file transfer operation and the RI sub-menu is displayed again.

The sub-menu is self-explanatory, however, it may be necessary to clarify that the word 'Refresh' refers to the NORPAK frame buffer where images to be displayed are stored. The detailed operation of each RI selection is described in the following sub-sections. If the code entered is in error, the sub-menu is repeated.

5.3.2 Tape to Disk (TD)

5.3.2.1 Introduction

The TD command is used for transferring images from magnetic tape to disk files. The user is asked to mount a tape and then enter the format of the image data on the magnetic tape. If mounting is unsuccessful an error message is sent giving the tape status and the RI menu is displayed for a new start.

```
--- TAPE TO DISK ---

- HIT 'CR' WHEN TAPE IS MOUNTED
```

If the tape is mounted successfully, the tape format sub-menu is displayed.

```
- - - TAPE TO DISK - - -

Tape formats available:
- Standard Format                (ST)
- ERIM Format                    (ER)
- Return to Route Image Menu     (RT)

- Enter Two-Character Code      > __
```

WARNING: It is imperative that the operator does not enter (erroneously) the ER selection for an ERIM data base when a standard tape is mounted on the deck, because as yet no check is made for an ERIM tape and "garbage" will be printed on line printer and could cause the SUPERTERM printer terminal to be put off-line.

5.3.2.2 ERIM Format Tape (ER)

When ERIM Format is selected , the ERIM header (first record on tape) is read to get the frame characteristics of the

The System Parameters List and Updates (SP) package is used to list on the console and/or line printer the headers of image files stored on disk, tape and the refresh banks of the NORPAK frame buffer, and to update the user comment part of the header of image disk files. It is also possible to list on line printer the Image LOG file and to create a new LOG file.

The Multispectral Image Analysis (MS) package is used to:

a) ratio two multispectral images,
b) classify one class in one to six bands of multispectral imagery,
c) create an intensity correlation plot (scattergram) of two bands of an image,
d) compute algebraic combination of images.

The Monospectral Image Analysis (SS) package is used to perform image manipulations such as: histogram equalization, level slicing, zooming and pixel intensity dump.

The EXIT command (EX) terminates the IMAGER program.

After an operation package is selected from the main menu, the system will not return automatically to the main menu level when the selected operation is terminated, unless requested to do so by the operator when this operation sub-menu is displayed.

If the code entered by the operator is in error, the main menu is repeated.

5.3 ROUTING IMAGE PACKAGE (RI)

5.3.1 Introduction

The RI command brings the following sub-menu to the console.

```
        - - -  ROUTE  IMAGE  MENU  - - -

    - Tape  to  Disk                    (TD)
    - Disk  to  Tape                    (DT)
    - Disk  to  Refresh                 (DR)
    - Refresh  to  Disk                 (RD)
    - Refresh  to  Monitor              (RM)
    - Return  to  Main Menu             (RT)

    - Enter Two-Character Code      >  __
```

5.2 MAIN MENU

When IMAGER is started as described in the previous section, the SYSTEM name and revision number appear on the console

```
****   IMAGER  3.00   *****
```

and the user is asked to specify if the NORPAK processor has to be initialized.

```
Do you wish to initialize the Image processor (Y or N)  >  _
```

This initialization resets all of the electronics of the RGP 3050 and clears all memory in the refresh buffers. It also deletes from disk the header files of former images stored in the refresh buffers. This must be done at least once after the power ON sequence. The capability of not initializing the processor at the beginning of the program permits the restart of IMAGER without the loss of any images resident in the refresh buffers, values in the look up tables (LUT), colour and bank switches. After the decision on initialization is made, the main MENU appears on the console as follows:

```
***  I M A G E R  M A I N  M E N U  ***
     ******************************

- Route Images                                (RI)
- Geometric Operations                        (GO)
- System Parameters List and Update           (SP)
- Multispectral Image Analysis                (MS)
- Monospectral  Image Analysis                (SS)
- Exit                                        (EX)

- Enter Two-Character Code                 >  __
```

Each selection, with the exception of EX "Exit", results in a sub-menu for the execution of the required operation.

The Route Image (RI) package is used for the routing of images between tape, disk and the NORPAK refresh buffers.

The Geometric Operations (GO) package will be used to rectify and register line scanner imagery. The implementation of this section is not yet complete and its selection will force the program to terminate abruptly and to return to CLI. For measure of completeness, the description of the this package will be found in paragraph 5.4.

The reverse sequence of the power on procedure is taken to switch off the power for the complete system.

1. Turn computer key to OFF position.
2. Set the drive switch to the STOP position to cause the heads to unload and the spindle to stop.
3. Turn off the tape drive.
4. Finally switch off the circuit breakers in the electrical box behind the computer cabinets.

4.4 MAGNETIC TAPE USAGE

A detachable plastic ring called a "Write Ring" is used to enable the writing of data to tape. When the write ring is taken off, the tape cannot be overwritten.

The mounting of the tape on the deck is done as follows. The tape is placed on the hub, secured and threaded to the take up wheel. The POWER ON, LOAD and READY switches are flipped in sequence. When the tape is positioned at the LOAD POINT, the READY light and beginning of tape (BOT) light will be on. If the write ring is not on the tape the WRITE PROTECT light will also be on.

To dismount a tape the RESET switch and the UNLOAD switch are pressed. If the tape is not at the LOAD POINT (BOT light off), it will be rewound and the air pressure in the vacuum columns will be released. The UNLOAD switch must be pressed again and held until the tape is completely rewound.

SECTION 5: IMAGER SYSTEM OPERATION

5.1 INTRODUCTION

All information required for an operator to use IMAGER is given in this section. The MENU system of entering commands is explained and examples of computer output on the user terminal and line printer are described.

The user enters a carriage return (CR) and the Disk Bootstrap Loader reads SYS.SV, which is the disk filename of the RDOS operating system, into the computer and then relinquishes control to RDOS. RDOS requests the current date (month, day, year) and time (hours in 24, minutes and seconds).

```
MAPPED ECLIPSE RDOS REV 6.62
DATE (M/D/Y) ?  7 11 79
TIME (H:M:S) ? 10 37
R
```

The "R" prompt indicates the RDOS Command Line Interpreter (CLI) is ready to accept a command.

The final step in starting the IMAGER system is to select the IMAGER directory where the program and all the related files reside and start the program IMAGER. The following CLI (operating system) commands are used:

```
R
DIR IMAGER
R
IMAGER
```

Typing IMAGER requests RDOS to look for the program stored in the disk file IMAGER.SV, load it into CORE and start execution. The program overlays contained in the OVERLAY file IMAGER.OL are also loaded into core.

4.3 POWER OFF SEQUENCE

To stop the system, RDOS CLI has to get control, so IMAGER is terminated using commands described in Section 3 and the CLI RELEASE command is sent to release the Master Directory in an orderly fashion.

```
R
RELEASE %MDIR%
```

RDOS outputs the following message and halts the computer.

```
MASTER DIRECTORY RELEASED
```

SECTION 4: GETTING STARTED

4.1 INTRODUCTION

This section provides a description of the correct power up/down sequence of the equipment, the starting of the disk operating system RDOS and the software commands to load and start the IMAGER program.

4.2 POWER ON SEQUENCE

The computer system including the disk and tape drives and the NORPAK Image Processor RGP-3050 are powered by actuating the circuit breakers in the electrical box behind the computer cabinets. This will power the RGP-3050, the colour monitor, the computer terminals and the DC circuits of the disk drive. The disk and tape drives and the computer must then be powered up individually using actuators on their front consoles.

The disk drive (200Mb) has three rocker switches on the front console. The two leftmost switches for (1), 'DC Power ON', and (2), 'Write Enable' are normally set to their operating position, so they do not need to be actuated. After making sure a disk pack is installed on the spindle and the CHECK light near the DC POWER switch is off, the DRIVE switch is set to the START position and the disk pack should begin to rotate. When the READY light goes on, the disk drive is ready to accept and execute the commands of the program.

The computer is turned on by turning the key-switch to the ON position. When the ready light on the disk drive becomes illuminated, RDOS is booted by setting the computer data switches to 100067 octal (Switches 0, 10, 11, 13, 14 and 15 up, others down), then lifting the RESET switch on the computer front panel followed by lifting the PROGRAM LOAD switch. This loads from disk (unit 67) and starts execution of the Disk Bootstrap Loader which asks:

FILENAME?

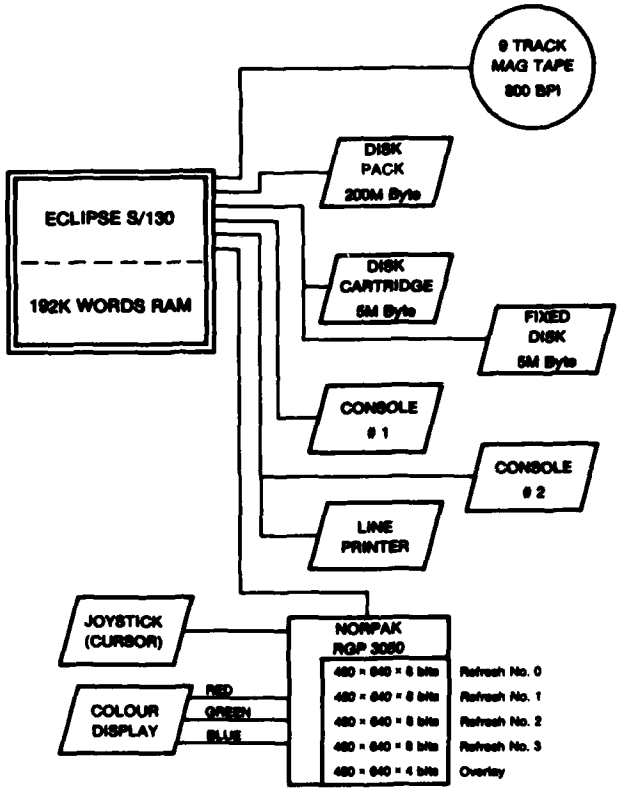


FIG. 3.1 DATA GENERAL ECLIPSE S-130 COMPUTER SYSTEM

3.4 SYSTEM ENVIRONMENT

The IMAGER program runs under the Data General Real Time Disk Operating System (RDOS) with an Eclipse S-130 computer having 192K words of memory and microprogramed with the floating point and character instruction set. The storage peripheral units are composed of two disk drive subsystems of 10 and 200 megabytes and a 9-track tape drive of 800 BPI running at 75 IPS. The small disk unit has two disks of 5 Mbytes of storage each. One is fixed and the other is a removable cartridge. The disk pack and the cartridge contain the bootstrap program used to start up RDOS. The IMAGER program is stored in a sub-directory in the disk pack which is also called IMAGER.

Two computer terminals are part of the computer system which allows two programs to be run simultaneously in a foreground/ background mode. There is no line printer as such, but the second terminal is linked to the line printer routines so that it can be used as a line printer. Since IMAGER uses the line printer, the second terminal is monopolized and RDOS prevents any further use of it in the foreground, making dual programming impossible (see fig. 3.1).

One of the most important pieces of hardware is the NORPAK R-3050 Image Processor. It contains enough memory to store 4-480X640 x 8 Bits images and 4 bits of overlay memory which can overlay graphs in 7 colours on the image without destroying the image itself. More precisely, the NORPAK memory can actually store 512 lines but only 480 can be displayed at one time.

Different selectors and 7 Look-Up-Tables (LUT) might be used to modify the fixed value for any colour gun and create pseudo-colour for any of the stored images. A hardware cross cursor may be placed on the display and moved either by program control or by an interrupt joystick. The position of this cursor can be read back and used for control as well.

After all desired data transfers have been specified to the satisfaction of the operator, the transfers are started by entering a zero when IMAGER requests the disk file number.

```
TRANSFER No. nn

- INPUT SOURCE DISK FILE (0 FOR END) 0
```

When 4 transfers have been specified, the start is automatic. At each transfer a message is displayed to the console.

```
>>>  Image no   n  Being Loaded into Refresh Buffer no  n  <<<
```

After each successful completion of a data transfer, this message is printed on the line printer.

```
FILE TRANSFER  nn
     DISK NO.  nn TO REFRESH BANK  nn COMPLETE
```

It should be noted that an image being written into the display processor is displayed in black and white on the colour TV monitor.

5.3.5 Refresh to Disk (RD)

The command RD is used to transfer images from the NORPAK Refresh Buffers to disk files. For each transfer a 4-character source tape-id and a user comment are requested. These are inserted in the image file header and the LOG file when the disk file is created. The output file sequence number is displayed on the console and printed on the line printer.

The console screen appears as follows:

```
- - -  REFRESH  BUFFER  TO  DISK  - - -

        Refresh Image Transfer no.   1

- Enter Refresh Buffer no.  ( 0-3, Neg to END )  > _

- Enter the Source Tape ID of this DATA  ( 4 chars ) > ____

This is first line of comments
and this is the second one

---  OUTPUT file sequence no. is      n  ---
```

When it is time to input the comment, two messages appear consecutively on the last line of the console

```
 - Enter  1  or  2  lines of comment - 100 characters MAX
        and
   You may enter more comments !
```

During the refresh to disk transfer the following message is repeatedly sent to the console:

```
     >>>  TRANSFERRING line   n   <<<
```

where n is the scanning line number being transfered to disk.

After the completion of every transfer the following message in send to the line printer,

```
TRANSFER no.  n:  REFRESH BUFFER no.  n  ROUTED to ...
                            ...  DISK IMAGE FILE no.  n
```

and the refresh buffer query reapears on the console screen.

If the refresh buffer number entered is negative the RD operation ends and the Route Image menu is displayed.

5.3.6 Refresh to Monitor (RM)

5.3.6.1 Introduction

The RM command is used to select which refresh buffer will be displayed on the colour TV monitor. It allows also more sophisticated users to gain access to the RGP-3050 Image Processor advanced commands.

5.3.6.2 Display a Bank

The normal mode of the RM command consist only in prompting the user to enter the refresh buffer number of a grey scale image to be displayed on the colour monitor. Following a correct answer, ie a number between 0 and 3, that bank is displayed on the monitor. With a negative value the program will return the Route Image menu.

```
- - -  REFRESH  TO  MONITOR  - - -

- Which bank to display (-ive for Menu)  > _
```

After the selection this message is also displayed

```
DISPLAYING  Refresh Bank :  n
```

5.3.6.3 RGP-3050 Advanced Commands

5.3.6.3.1 Introduction

If for the above query the value 99 is entered, the RGP-3050 Advanced Command menu is displayed to the console in order to let a user access to some of the RGP-3050 Image Processor's intrinsic commands.

With this menu, an operator can select any available refresh bank to be connected to any of RED, GREEN and BLUE colour guns or to the pseudo colour look-up-tables (LUT). Calibrate and video LUT's can be selected and modified, overlay memories can be enabled or disabled, and vertical and horizontal scaling lines can be traced on the TV monitor to delimitate pixels and scanning lines.

For successful use of this feature, it is imperative that the operator has sufficient knowledge of the internal working of the RGP 3050 Image Processor.

The console screen will look like this:

```
- - -  RGP-3050  ADVANCED  COMMANDS  - - -

 - Load banks                          (BK)      VT  BIAS  AMPL
 - Load calibrate select               (CA)  or VT  FROM   TO  FVAL
 - Load colour select                  (CO)
 - Load video table                 (VTorWD)    0     n     n
 - Enable  Overlay                     (EO)
 - Disable Overlay                     (DO)     2     n     n   n
 - Select Overlay Bits for RGB guns    (OB)     3     n     n
 - Trace  Scaling lines                (TS)
 - Toggle Scaling lines                (TG)
 - Return to Route Image Menu          (RT)     6     n     n

 - Enter Two-Character Code       >  __


     R  G  B  PSC              B0 B1 B2 B3          SCALING LINES
BANK n  n  n  n          CAL n  n  n  n               H = n
PCM  n  n  n                                          V = n
OVBT n  n  n
```

Each selection brings its own query in the empty area below the menu. In the case of an operator input error, the usual error message is displayed on the last line of the console.

After the execution of the selected operation, this screen area is selectively erased and the particular table at the bottom or on the side of the screen is updated.

To terminate, the RT selection will get the Route Image menu to come back to the screen.

5.3.6.3.2 Load Banks (BK)

This command is for the selection of the refresh banks that will be connected to red, green and blue guns and to pseudo-colour LUT. The 4 numbers required by this command are used directly by the NORPAK library subroutine LBK.

```
CALL LBK - Banks (0-3)
  Enter  Red, Green, Blue and  Pseudo Colour Banks >  _ _ _ _
```

5.3.6.3.3 Load Calibrate Select (CA)

This command is used to select whether or not the image in a refresh buffer (or bank) is to be preprocessed by its calibrate table (LUT). A zero deselects the LUT and a one selects it. The zeros and ones entered for banks 0,1,2,3 are used directly by the NORPAK library subroutine LCA .

```
CALL LCA - Enable  Banks calibrate tables ( 1 )  or  Not ( 0 )
  Enter Banks  0,1,2,3 calibrate select bits    > _ _ _ _
```

5.3.6.3.4 Load Colour Select (CO)

This command is used to select whether or not the signal going to a colour gun is preprocessed by its pseudo colour LUT. A zero (0) selects the bank and a one (1) the pseudo-colour memory. The zeros and ones entered for the red, green and blue guns are used directly by the NORPAK library subroutine LCO.

```
CALL LCO - Enable Pseudo Colour ( 1 ) or Not ( 0 )
  Enter  Red, Green and Blue  Colour Select   >  _ _ _
```

5.3.6.3.5 Load Video Table (VT or WD)

These two commands allow the modification of any one of the 7 LUT's found in the system. The first four (0-3) are the calibrate tables of each of the four banks (0-3) and the last three (4-6) are the pseudo-colour tables of the red, green and blue guns respectively.

With the command VT the NORPAK library subroutine VTABLE is called to load all the 256 values of a video table. The 3 arguments required are:

1. the LUT table no. (0-6) - TABLE -,
2. the first value in the table (+/- 0-255) - BIAS -,
3. and the increment given to each sequential value in the table (+/- 10) - AMPLIFICATION -.

It should be noted that as the LUT has only an 8-bit word, each value in the table is then resolved to be modulo 256.

```
CALL VTABLE  ( L.U.T. Modification )
  Enter  Table (0-6) , Bias (+/- 255) , ...
                          ... Amplification (+/- 10)  > _ _ _
```

With the command WD only a range (or a window) of the intensities of an image can be displayed. The pixels whose intensities are outside the window are zeroed. The other pixels are displayed with their intensities stretched between a First Value Displayed and 255. Four numbers are requested as input, the Look up Table no, the first and last intensities delimiting the window and the first value displayed on the monitor.

```
LUT#,  Window: From, To,  First intensity displayed _ ___ ___ ___
```

5.3.6.3.6 Enable (EO) or Disable (DO) Overlay Memory

This is self explanatory, the NORPAK library subroutines OVRON and OVROFF are called to enable or disable the overlay bits to be displayed.

5.3.6.3.7 Select Overlay Bits for R,G,B Guns (OB)

The three NORPAK library subroutines LROV, LGOV and LBOV will be called to select which of the 4 overlay bits will be displayed by the three red,green and blue colour guns. The 3 acceptable values are between 0 and 4, with 4 meaning that a particular colour gun will not display any overlay bit.

```
- Enter Red, Green and Blue Overlay Bits
  ( 0 to 3,  4  will disable a colour)  > _ _ _
```

5.3.6.3.8 Trace (TS) or Toggle (TG) Scaling lines

With the TS selection vertical and horizontal scaling lines are traced on the TV monitor using bit 3 of the overlay memory. Two numbers are requested to set the scaling separation between the lines.

- Enter Hor. and Vert. Scaling Lines > _ _

The TG selection will permit to toggle ON and OFF the display of these overlay scaling lines. The routines OVRON and OVROFF will be called alternately.

5.4 Geometric Operations Package (GO)

Note: These functions have been implemented but final debug has been delayed because of hardware interaction with the disk subsystem and the NORPAK image processor when read-back operations are done. There were also problems related to the usage of cursor interrupt simultaneously with writing to the overlay memory. These problems have been resolved and the registration of imagery package might be fully implemented in some future release of the IMAGER program.

5.4.1 Introduction

The GO command brings the following sub-menu to the console:

```
*** GEOMETRIC OPERATIONS ***

- Rectification and Registration      (RR)
- Return to Main Menu                 (RT)

- Enter Two-Character Code          > --
```

The sub-menu is self-explanatory. If the code entered is in error, the sub-menu is repeated.

5.4.2 Rectification and Registration (RR)

5.4.2.1 Introduction

The RR command brings the following sub-menu to the console. The sub-menu is self-explanatory. If the code entered is in error the sub-menu is repeated. The detailed operation of each RR selection is described in the following sub-sections.

```
*** RECTIFICATION AND REGISTRATION MENU ***

-  Get Ground Control Point              (GC)
-  Compute Coefficients                 (CC)
-  Transform Image                      (TI)
-  Return to GEOP Menu                  (RT)

-  Enter Two-Character Code          > --
```

5.4.2.2 Get Ground Control Points (GC)

5.4.2.2.1 Introduction

After the Registration and Rectification Menu has been displayed on the console, the GC command makes the acquisition of ground control points possible. IMAGER asks the operator to identify the filename to be used as follows:

```
- - - DISK FILES IDENTIFICATION - - -


-  PLEASE Enter GCP filename (no EXT.)

-  FILENAME?
```

The operator can chose a filename up to 8 characters in length. Suppose the filename "TEST2" is chosen. IMAGER rechecks to see if the operator has chosen the desired name by sending the following message to the console.

```
-  Complete filename is:  TEST2.GC
   Do you want to change it?  Enter CR or Y > __
```

If the operator inserts "Y", the prompt for another filename is repeated, otherwise, IMAGER asks for the reference file number as follows:

```
-  Enter reference file no.  > __
```

The reference file number must be within the range from 1 to 16 inclusive. If the chosen file number does not exist, the following message is sent to the console:

```
--- Reference Disk file no.  nn  does not exist
```

If any errors occur the operator is prompted for a new reference file number.

After the operator has successfully chosen an existing file number, IMAGER asks for the source file number as follows:

- Enter Source file no. > __

If the operator inputs the same source file number as he used for the reference file number, the following message is sent to the console:

--- Reference and Source file numbers should be different

and the prompt is sent to the console for a new source file number.

In the following example, assume that the operator has chosen the existing files 1 and 2 for the reference and source file numbers respectively. The following information would be displayed on the console screen:

GROUND CONTROL POINTS FILE INFORMATION

- REF	HEADER			
1	FLIGHT DATE	8/28/75	XEROX TAPE NO.	2G04
	V/H RATIO	0.170	HEADING IN DEG.	316
	ALTITUDE (FT)	1200	BAND NUMBER	10
	START LINE NO.	100	LINE INCREMENT	1
	START PIXEL NO.	3	NO. PIXELS/LINE	640
	NO. OF LINES	480		
- SRC	HEADER			
2	FLIGHT DATE	8/28/75	XEROX TAPE NO.	2G06
	V/H RATIO	0.170	HEADING IN DEG.	316
	ALTITUDE (FT)	1200	BAND NUMBER	12
	START LINE NO.	150	LINE INCREMENT	1
	START PIXEL NO.	3	NO. PIXELS/LINE	640
	NO. OF LINES	480		

- GCP filename	TEST2.GC
- Reference Image file no.	1
- Source Image file no.	2
- Number of Ground Control Points	0

The reference and source images are written to the TV monitor at one-quarter their normal size. The images are displayed on the right half of the television screen with the reference image at the top and the source image at the bottom. After the images have been displayed, the operator is notified that IMAGER is ready to continue by the following message sent to the console:

PAUSE 'IMAGES LOADED - ENTER C/R TO CONTINUE'

The operator should note that if the GCP filename chosen had already existed, he would have been asked if he wanted to change the name, as before. Once this decision was made the Ground Control Points File Information would have been written to

the console, without asking for file numbers, and the images loaded as above. In addition, if any ground control points existed, their coordinates would be listed as follows:

GROUND CONTROL POINTS

POINT	REFERENCE IMAGE U	V	SOURCE X	IMAGE Y
1	240	440	100	100
2	260	440	100	120
3	280	440	100	140
4	300	420	120	160

If an existing filename is used, a check is made to see if either the source or reference files have changed. If they have, error messages are sent to the line printer.

In case of errors, processing is aborted and the Rectification and Registration Menu is displayed on the console.

When the operator is ready to proceed, the carriage return is hit and the Ground Control Point (GCP) Menu is displayed on the console as follows:

```
***  GROUND CONTROL POINT MENU  ***

-  Set Image Magnification          (IM)
-  Set Brightness Offset            (BO)
-  Set Intensity Factor             (IF)
-  Print Status Information         (PS)
-  Add Ground Control Points        (AD)
-  Delete Ground Control Points     (DE)
-  Display Error Analysis           (EA)
-  Return to RREG MENU              (RT)

-  Enter Two-Character Code        > --
```

The GCP Menu is self-explanatory. If the code entered is in error, the submenu is repeated. The detailed operation of each GC selection is described in the following sub-sections.

5.4.2.2.2 Set Image Magnification (IM)

If the operator inserts "IM" when the Ground Control Point Menu is displayed on the screen, this indicates that a magnification of a portion of the reference image and source image is desired. The operation being performed is identified on the screen as follows:

- - - MAGNIFICATION FACTOR - - -

The Reference and Source images can be MAGNIFIED
on the left side of Screen Monitor

The operator then is asked to input the magnification factor (in the range of 1 to 10 inclusive)

- Please give a number between 1 and 10
  as a Magnification Factor > __

When the magnification has been completed, the Ground Control Point Menu is displayed on the screen.

5.4.2.2.3 Set Brightness Offset (BO)

If the operator inserts "BO" when the Ground Control Point Menu is displayed on the console, IMAGER attempts to get two brightness offsets that will be added to the values of the reference and source image after which they are displayed on the left side of the monitor screen. The operation being performed is identified on the console as follows:

- - - BRIGHTNESS OFFSET - - -

Every pixel value of the Reference and Source images can be modified with an additive Brightness Offset value

The operator then is asked to input two brightness offset parameters within a given range.

- Please give two (2) numbers between -255 and 255
  as Brightness Offset values > __

When the brightness offset has been completed, the Ground Control Point Menu is displayed on the console.

5.4.2.2.4 Set Intensity Factor (IF)

If the operator inserts "IF" when the Ground Control Point Menu is displayed on the console, IMAGER attempts to get two intensity factors that will multiply the values of the reference and source image after which they are displayed on the left side of the monitor screen. The operation being performed is identified on the console as follows:

- - - INTENSITY FACTOR - - -

Every pixel value of the Reference and Source images can be modified with a multiplicative Intensity Factor

The operator then is asked to input two intensity factors within a given range.

- Please give two (2) numbers between 1 and 10
  as Intensity Factors > __

When the intensity factor has been correctly chosen, the Ground Control Point Menu is displayed on the console.

5.4.2.2.5 Print Status Information (PS)

If the operator inserts "PS" when the Ground Control Point Menu is displayed on the screen, IMAGER prints on the line printer the availble information about the reference and source images as follows:

--- STATUS INFORMATION ON FILES
--- AND GROUND CONTROL POINTS

- Ground Control Point file name: TEST2.GC

- HEADER REF FILE NO. 1

1	FLIGHT DATE	8/28/75	XEROX TAPE NO.	2G04
	V/H RATIO	0.170	HEADING IN DEG.	316
	ALTITUDE (FT)	1200	BAND NUMBER	12
	START LINE NO.	150	LINE INCREMENT	1
	START PIXEL NO.	3	NO. PIXELS/LINE	640
	NO. OF LINES	480		

- HEADER SRC FILE NO. 3

3	FLIGHT DATE	8/28/75	XEROX TAPE NO.	2G04
	V/H RATIO	0.170	HEADING IN DEG.	316
	ALTITUDE (FT)	1200	BAND NUMBER	10
	START LINE NO.	100	LINE INCREMENT	1
	START PIXEL NO.	3	NO. PIXELS/LINE	640
	NO. OF LINES	480		

- Number of Ground Control Points 7

GROUND CONTROL POINTS

POINT	REFERENCE IMAGE U	V	SOURCE IMAGE X	Y
1	240	440	100	100
2	260	440	100	120
3	280	440	100	140
4	300	420	120	160
5	171	297	171	296
6	123	83	159	114
7	393	361	159	120

After the information about the reference and source images contained in the .GC file has been printed on the line printer, the Ground Control Point Menu is displayed on the screen.

5.4.2.2.6 Add Ground Control Points (AD)

If "AD" is inserted when the Ground Control Point Menu is displayed on the screen, this indicates that the operator wants to add ground control points to the reference and source images. All previously chosen ground control points (if any) are displayed on the right half of the TV display. The operation being performed is identified on the console as follows:

- - - GROUND CONTROL POINTS ACQUISITION - - -

- Do you want tc enter the GCP's via the keyboard (Y or CR)? >

The operator is given two ways of adding the ground control points. He can enter them via the keyboard or by using the joystick.

If he wishes to enter them via the keyboard he inserts a "Y" after the previous question. Then the operator is prompted for the reference coordinates

- Please enter the GCP no. nn coordinates
  for the Reference image (zero to end) > __

where nn is the No. of GCP's +1.

If the first coordinate of the reference image is less than or equal to "0" an exit is made from adding ground control points and the GCP Menu is displayed on the console.

The first coordinate should be between 1 and 640 and the second one between 1 and 480.

After the operator has successfully chosen the coordinates, the GCP is displayed on the reference image. The following prompt then appears on the console:

- Plese enter the GCP no. nn coordinates
  for the Source image > __

An exit cannot be made to the GCP menu by inserting a number less than or equal to "0" as in the previous case of the reference GCP. Once the operator has selected a reference GCP, a source GCP must be chosen.

After the operator has successfully chosen the coordinates, the source GCP is displayed on the source image and the operator is asked for the coordinates of the next GCP, beginning again with the reference first.

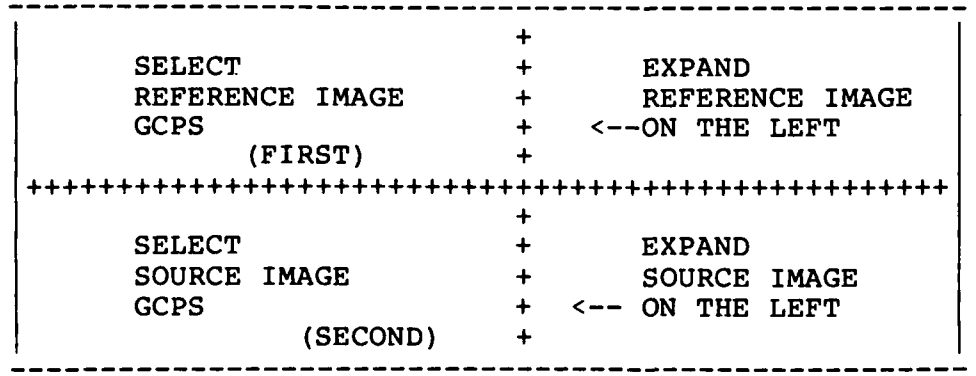
The other method of entering the GCP's is via the joystick. Once the operation being performed has been identified, the following query appears on the screen.

- Do you want to enter the GCP's via the keyboard (Y or CR)? >

The operator can enter the GCP's via the joystick by pressing the "carriage return" (or anything but a "Y").

The following graphic message is displayed on the console to show the operator how to use the cursor to select the GCP's, and how to use the keyboard interrupt commands.

- - - GROUND CONTROL POINT ACQUISITION - - -
VIA JOYSTICK AND CROSS CURSOR



CURSOR COMMAND DIAGRAM

NB - PRESS THE JOYSTICK BUTTON FOR A CURSOR COMMAND
- PRESS A KEY FOR A KEYBOARD COMMAND

first log entry will be an incremented value of the last one in the former LOG file.

After the LOG file creation the program returns the SPLU menu.

5.6 MULTISPECTRAL IMAGE ANALYSIS (MS)

5.6.1 Introduction

When this option is chosen the operator is given several choices via the menu below.

```
- - -     MULTI  SPECTRAL     - - -
        IMAGE  ANALYSIS  MENU

- Image Ratio                          (RA)
- Intensity Correlator                 (CO)
- Image Classifier                     (CL)
- Colour Composite Image               (CC)
- Algebraic Combination of Images      (AC)
- Return to Main Menu                  (RT)

- Enter Two-Character Code        >  __
```

These menu selections allow the operator to select an algorithm for the processing of multispectral imagery. However the fourth selection, 'Colour Composite Image', is used only to display one to three multispectral images on each of the three colour guns of the TV monitor. With the multispectral image analysis package, it is possible to ratio two multispectral images and adjust the result for the display, to classify 1 to 6 multispectral images for one target using a Gaussian technique and to algebraically combine together a number of multispectral images by simply entering the algebraic equation at the keyboard.

The results of the selections are described in the following subsections.

5.6.2 Ratioing Two Images (RA)

The Ratio operation consists of dividing the corresponding pixel intensities of two images and multiplying and shifting the result to improve the brightness and contrast of the image displayed on the TV monitor. The denominator pixel

For an Algebraic Combination of Images, the log appears as follows:

```
        - - -  LOG  FILE  LISTING  - - -

Sequence No. :    140        Date :   7/30/1981
                             Time :  11:53: 0

Comment :

Ratio operation test

        >>  ALGEBRAIC  COMBINATION  OPERATION  <<

        Parent Images are:    138     29

        The equation used is:

<2>=(100*((<8>+.00000001)/(<7>+.00000001)))+10+.5
```

For a Refresh to Disk Image transfer, the log appears as follows:

```
        - - -  LOG  FILE  LISTING  - - -

Sequence No. :    288        Date :   9/17/1981
                             Time :  14:38:49

Comment :

CS13 | FL-21 | Lines 1150 - 1629 | Band 4 |
Frame 51 | High Butte - Big Belly Trail |

Source tape :  CS13
```

5.5.5.3 Create a New LOG File (CL)

This selection deletes the actual LOG file named IMAGER.LO and creates a new one. The first sequence no of its

For a Ratio Image, the log appears as follows:

- - - LOG FILE LISTING - - -

Sequence No. : 208 Date : 8/10/1981
Time : 8:42:11

Comment :

>> RATIO OPERATION <<

SEQUENCE NO		RATIO PARAMETERS	
Numerator	28	MLTPR	128.0
Denominator	24	SHIFT	.0
		PWR	1.0

For a Classification Image, the log appears as follows:

- - - LOG FILE LISTING - - -

Sequence No. : 30 Date : 7/17/1981
Time : 11:19:22

Comment :

TAPE 9 LINE 11 1000FT DAY LINES 760-1239
CLASS. BANDS 11 10 6 4 5

>> CLASSIFICATION OPERATION <<

PARENT IMAGE	SIGNATURE	ERROR
28	236	11
27	190	13
26	30	3
25	34	2
29	33	2

Confidence Level .9900

- Enter FIRST and LAST Log Sequence no's to be printed > __

With the command PL, all the logs will be printed.

For clarity and document storage purpose only one log per page will be printed.

There are 5 different formats for the log printing depending on the origin of the image. If an image is the result of an operation performed on several images, the sequence numbers of all these images are listed as well as all of the parameters used to perform the operation.

For an ERIM Image, the log appears as follows:

- - - LOG FILE LISTING - - -

Sequence No. : 292 Date : 10/ 3/ 75
Time : 21: 0: 0

Comment :

CITY OF GUELPH, ONTARIO

Source tape : 2G15

>> FRAME INFORMATION <<

	START	INCREMENT
Line	1	1
Pixel	3	1
Pixels/Line		640
No of Lines		480
Band ID		5

```
--- REFRESH HEADER LISTING ---

- ENTER REFRESH BANK NO. (-IVE FOR EXIT)  >  _
```

5.5.5 LOG File Printout (LO)

5.5.5.1 Introduction

This command instructs the program to list on the line printer all or a portion only of the log entries of the LOG file. It is also possible to delete the LOG file and create a new one.

The LOG file listing menu is:

```
- - -  LOG  FILE  LISTING  - - -

- Print the Entire Log              (PL)
- Print a portion of the Log       (PP)
- Create a New LOG File            (CL)
- Return to SPLU Menu              (RT)

- Enter Two-Character Code       >  __
```

If the LOG file is empty, ie if the LOG file printing is requested just after a new LOG file is created, the following message is sent:

```
---  LOG File is empty  -  Enter any char. to Cnue !!
```

but normally the following is displayed below the menu:

```
- First Sequence no :     n
- Last  Sequence no :     n
```

5.5.5.2 Print the Entire Log (PL) or a Portion of the Log (PP)

With the command PP, the operator is asked to give the range of sequence no's of the log entries he wishes to be printed.

listing is done, the operator is also asked if the comments are to be replaced or not.

```
- ENTER DISK FILE NO. (ZERO FOR EXIT)    > _
```

Then follows the listing and the query.

```
DISK FILE NO.     5

 Sequence No. :    288        Date :   9/17/1981
 Source tape  :   CS13        Time :  14:38:49

 Comment :  CS13 | FL-21 | Lines 1150 - 1629 | Band 4 |
Frame 51 | High Butte - Big Belly Trail |

 - REPLACE COMMENTS?  (Y or N)  >  _
```

A Y answer means the operator wishes to change the previous comments and causes the following two messages to appear consecutively on the last line of the console.

```
 - Enter  1  or  2  lines of comment - 100 characters MAX
        and
   You may enter more comments !
```

With an N answer or a CR the program continues.

When the user wants to terminate the listing he enters zero as a disk file number and the program returns the SPLU sub-menu.

5.5.4 Refresh Header List (RL)

This last listing command instructs the programs to list the file headers of images stored in any of the 4 memory banks of the NORPAK processor Frame Buffers. Like tape file headers, only the listing is done. It is not possible to modify the user comment.

The operator is asked which refresh bank header he wishes to list. After the listing is done another request is sent for another refresh bank number. If the number is negative the program returns to the SPLU sub-menu.

--- TAPE FILE HEADER LISTING ---

- HIT 'CR' WHEN TAPE IS MOUNTED

- ENTER RANGE OF FILES _,_

The range of files is specified by 2 numbers, the first and last file numbers. If these numbers are incorrect an error message is sent and the request is displayed again.

--- OPERATOR INPUT ERROR

- ENTER RANGE OF FILES _,_

If the first file number of the search is zero the operation is aborted and control returns to SPLU sub-menu.

When the listing is sent only to the console terminal the program pauses to allow the user time to read the information just displayed. The message

** HIT CR TO CONTINUE **

is sent and the program will list the next header after the operator has keyed a carriage return. On termination the magnetic tape is rewound.

If a tape file is non-existent or out of range, the operation stops and the tape is rewound, leaving this message on the line printer.

*** SPFIL - DOUBLE EOF ENCOUNTERED ***

Two EOF marks on a tape specify the end of data.

5.5.3 Disk Header List and Update (DL)

This command instructs the program to list image file headers from an image disk file. It also allows the operator to replace the 100-character user comment area. The operator is asked which disk file header he wishes to list. After the

5.5 SYSTEM PARAMETERS LIST AND UPDATE PACKAGE (SP)

5.5.1 Introduction

With this package it is possible to list on the console terminal and optionally on the line printer the headers of image files stored on tape, disk and refresh buffers. The content of the LOG file can also be listed on line printer. After baseline 3.00 the image file header will contain only a sequence no, a creation time and date, a user comment and in certain cases a magnetic tape identification label. All information concerning an image file are stored in the LOG file when it is created.

The SPLU menu is:

```
- - -  SYSTEM  PARAMETERS  LIST  AND  UPDATE  - - -

     - Tape Header List                    (TL)
     - Disk Header List and Update         (DL)
     - Refresh Header List                 (RL)
     - LOG File Printout                   (LO)
     - Return to Main Menu                 (RT)

     - Enter Two-Character Code        >  __
```

When a header listing is requested, SPLU asks the operator if the listing will be have to be send to the line printer or simply to the console terminal.

```
- Key-in  'LP'  to list on line printer  > __
```

Entering a carriage return (CR) will limit the header listing to the console.

5.5.2 Tape Header List (TL)

This command instructs the program to list image file headers from a standard format tape. The tape is checked for a standard format label and the user is requested to input the range of the tape file numbers for which he wants the headers listed. If any problems are encountered, tape messages (described in preceding sub-sections concerning standard format tape operation) will be sent to the line printer and the operation will be aborted. The SPLU sub-menu will be displayed again.

If the transformation file exists, IMAGER has all of the information necessary to transform the image. Therefore the operator is not asked for input. A check is made of the output file to see if it has changed from the one used previously. If changes have been made, an error message is printed on the line printer and then processing stops.

If the operator tries to transform an image that has had the desired transformation completed, the following message is printed on the line printer:

** GOTXF ** IMAGE HAS ALREADY BEEN TRANSFORMED

and then processing stops.

One final check is made for both conditions (i.e. existent or non-exisent transformation (.XF) file) as long as the ground control points (.GC) file exists. The source file header, contained in the .XF file, is checked against the original source file. If differences are present, an error message is printed on the line printer and the processing stops.

If no errors have been encountered up to this point, the process of sampling pixels from the refresh buffer and writing them to the output file begins. The following informative message appears on the screen:

** IMAGE TRANSFORMATION IS IN PROCESS **

- Hit "X" To Stop Image Registration
- Hit Any Other Key for the Current Line Number

The operator can terminate the sampling process by typing the letter "X". IMAGER then returns to the Rectification and Registration Menu after printing the following message on the line printer:

NEXT LINE TO BE TRANSFORMED IS nnn

If the operator does not want to stop the sampling but would like to know how far along the process has gone, entering any character (other than "X") will result in the following message being sent to the console:

THE CURRENT LINE NUMBER IS nnn

Once the processing of an image is complete, the following message is printed on the line printer:

** IMAGE TRANSFORMATION IS NOW COMPLETE **

and the Rectification and Registration Menu is displayed on the console.

If there is no transformation (.XF) file, but a ground control point (.GC) file exists, a transformation (.XF) file of the same name is created. The .XF file is checked to establish the existence of the transformation coefficients. If all coefficients are zero, the operator is notified via the line printer of the non-existence of the transformation coefficients.

```
- THE TRANSFORMATION COEFFICIENTS DO NOT EXIST.
```

The Rectification and Registration Menu is displayed on the screen after the processing has been aborted. If at least one transformation coefficient is not zero, the operator is asked for the output file number.

```
- ENTER THE OUTPUT FILE NO. (1-16)  >  __
```

The input number is checked against the source file number. If the two numbers are the same, the operator is notified and asked for a new output file number.

```
--- OPERATOR INPUT ERROR
- THE OUTPUT FILE AND SOURCE FILE CANNOT USE THE
  SAME FILE NUMBER
- ENTER THE OUTPUT FILE NO. (1-16)  >  __
```

If the selected file exists and is write protected, the operator must decide whether or not to overwrite the existing file.

```
- DISK FILE nn IS WRITE PROTECTED.
DO YOU WISH TO OVERWRITE?  (Y or N)  >  _
```

If the operator does not want to overwrite the existing file, N is entered, and he is asked again for a new output file number. If a Y is entered, the processing continues.

After the output file number has been selected, the operator is asked for the type of image correction that is desired.

```
          *** IMAGE CORRECTION ***

- NO CORRECTION                          (0)
- RECTILINEARIZATION                     (1)
- SLANT RANGE                            (2)
- RECTIFICATION                          (3)

- ENTER NUMBER CODE DESIRED              >  -
```

Using all of the information obtained from the operator, the output file header is created. If problems arise in the creation of the output header the program will abort the processing.

** CCOEF ** THE XXXX FILE DOES NOT EXIST

Otherwise , IMAGER checks to make sure that there are at least four sets of ground control points in the .GC file that will be used to calculate the transformation coefficients. If there are less than four sets, the following message is sent to the line printer:

** AFFIN ** INSUFFICIENT DATA

and all processing is stopped.

Once the coefficients have been calculated, they are written to the .GC file along with the ground control points that were originally read from that file. The following information is written to the line printer:

*** FILENAME .GC **

No. OF GCPS nn
U,V TO X COEFS
.nnnnnEnn .nnnnnEnn .nnnnnEnn .nnnnnEnn .nnnnnEnn .nnnnnEnn

U,V TO Y COEFS
.nnnnnEnn .nnnnnEnn .nnnnnEnn .nnnnnEnn .nnnnnEnn .nnnnnEnn

UAV = nnn.nnnn VAV = nnn.nnnn

after which the Rectification and Registration Menu is displayed on the console.

5.4.2.4 Transform Image (TI)

The TI command is used when the operator wishes to transform an image. In the event of an error (other than an operator input error), the operator should note that the error is printed on the line printer, all open channels are closed, all processing is aborted, and the Rectification and Registration Menu is displayed on the console.

The operator is informed on the console, of the function being performed

*** IMAGE TRANSFORMATION ***

The operator is then asked to input a filename.

- FILENAME?

** ERRAN ** ERROR ANALYSIS ABORTED
MUST HAVE AT LEAST n MORE GCP's TO PROCEED

(where n = 4- the present number of GCP's)

after which processing is aborted and the GCP Menu as displayed on the console.

If there are at least four ground control points, the operation being performed is identified on the console screen as follows:

--- GROUND CONTROL POINT ERROR ANALYSIS ---

Using the existing ground control points, the coefficients for u, v to x and u, v to y are computed. The heading for each column of the table is written to the console screen and subsequent entries for each column are calculated. The actual error calculation is the difference between the operator chosen ground control point coordinates and the calculated coordinates.

5.4.2.3 Compute Coefficients (CC)

The CC command is used when the operator wishes to compute the required coefficients and averages, to register the source image with the reference. The operator should note that if an error message is sent to the line printer, all processing is aborted and the Rectification and Registration Menu is displayed on the console.

The operator is asked to input a filename.

-FILENAME?

IMAGER then checks to see if there exists a transformation (.XF) file with this name. If such a file exists, the following message is sent to the line printer:

** CCOEF ** A .XF FILE ALREADY EXISTS

and the processing is stopped.

If no transformation file exists, IMAGER checks for a ground control points (.GC) file. If the .GC file does not exist, all processing stops and the following message is sent to the line printer:

Three other keyboard interrupt commands M, B, and I are also implemented. Their purpose is to modify the scale factor (M), the brightness offset (B) and the intensity factor(I). These are similar commands to the ones described in the GCP MENU with code IM, BO and IF respectively, with the exception that the scaled images on the left side of the monitor are immediately refreshed to show the changes made to the display parameters.

5.4.2.2.7 Delete Ground Control Points (DE)

If the operator inserts "DE" when the GCP Menu is displayed on the console screen, this indicates that he desires to delete some existing ground control points. The operation being performed is identified on the console as follows:

- - - DELETION OF GROUND CONTROL POINTS - - -

Following the identification, the operator is prompted for the number of the GCP to be deleted.

- Please enter the Ground Control Point no. (0 to return) > __

If the operator wishes to exit from this routine, a number less than or equal to zero is input and the GCP Menu is displayed on the console.

Once the operator has chosen an existing GCP no. the GCP set is highlighted by writing two crosses in red over the X's on the two images as a means of identification. The operator is asked if the highlighted GCP's are the ones to be deleted.

- Is the GCP set highlighted in red the one to be deleted (Y or N)? >

If they are not to be deleted "N" is input and the operator is prompted for a new GCP no. If it is the correct one, it is deleted and the GCP's are renumbered. The operator is asked for the next GCP no. that is to be deleted.

5.4.2.2.8 Display Error Analysis (EA)

If the operator inserts "EA" when the Ground Control Point Menu is displayed on the console screen, this indicates that an analysis of the relative error between the computed and chosen ground control points is desired. Before the analysis begins, a check is made to see that at least four sets of ground control points exist. If there are less than four sets, the following message is sent to the line printer:

The following are also displayed on the right side of the console:

KEY	MODIFICATION
M	SCALE FACTOR
B	BRIGHTNESS
I	INTENSITY
X	EXIT TO MENU

KEYBOARD COMMAND

If the magnified portion has not been chosen, only the reference and the source image are displayed on the right half of the TV display, with the reference on the top and the source on the bottom as shown above. All previously chosen GCP's, if any, are displayed on the reference and source images on the right half of the screen. If the magnified portion is not displayed on the left, the first operation is to choose an area in the two images on the right to be magnified on the left. If the operator tries to pick ground control points from the left side of the screen without having a magnified image, the following message is sent to the console:

- DISPLAY magnified portion first!!

The operator must display the magnified portion before any GCP's can be chosen. He can magnify the reference image first and then choose the reference GCP's before magnifying the source image.

The operator should note that the "REFERENCE GCP's MUST BE CHOSEN FIRST". Therefore, if the operator has magnified both images and tries to select the source GCP first, the following message is sent to the console:

** Reference GCP Must Be Selected First **

After the reference GCP is chosen and the source image has been magnified, the following is sent to the console:

** Source GCP Must Be Selected Now **

If the operator moves the cursor to the wrong image, the prompt is repeated.

If at any time the operator wants to exit from this routine, this can be done by entering the keyboard interrupt character "X". It is important to note that if the operator exits after selecting only the reference GCP, it is not written to disk.

intensity can also be elevated to a power. If the output pixel is less than 0 it is set to zero and when it is greater than 255 it is set to 255. It must be noted that the intermediate division result of 0/0 is 1 and 1/0 is a large value.

For the Ratio operation, the operator enters the image file numbers of the two input image files and of the output file where the resulting ratio will be stored. The ratio equation is displayed on the console and the screen appears as follows:

```
- - -  IMAGE  RATIO  - - -

The RATIO operation uses the following equation:

                              Numerator   Image
RATIO =  MLTPR * ------------------------------- + SHIFT + .5
                 ( Denominator Image ) ** PWR


>>> Numerator   Image <<< - Enter input  image no. (0 for exit) >
>>> Denominator Image <<< - Enter input  image no. (0 for exit) >
>>> Output      Image <<< - Enter output image no. (0 for exit) >

- Default transformation coef's for SHIFT, MLTPR and PWR ...
                                                ... are  0, 1, 128
- Enter 'D' for default transformation coef's > _
```

When special ratio parameters are requested this query is sent:

```
- Enter transform coef's SHIFT, MLTPR, and PWR > _ _ _
```

and then the user is prompted to visually check the ratio parameters and to accept or reject them.

```
                **  RATIO  DATA  **

     IMAGE  FILES                EQUATION  PARAMETERS

     Numerator        5          MLTPR          1.0
     Denominator      6          SHIFT           .0
     Output           3          PWR           128.0

 Are these correct ?  (Y)es, (N)o, e(X)it  > _
```

Following an affirmative answer, the output file sequence no is displayed and a user comment for the file header and the LOG file entry can be entered if so desired.

```
--- OUTPUT file sequence no. is      n  ---

- Do you wish to enter a user comment (Y or N) > _
```

Following a Yes answer, these two messages appear consecutively on the last line of the console.

```
- Enter  1  or  2  lines of comment - 100 characters MAX
        and
  You may enter more comments !
```

5.6.3 Intensity Correlation Plot (CO)

The intensity correlation plot package produces a scattergram of pixel intensities of two images using the intensities as ordinates. Areas from the images are chosen for plotting in colour against a grey background.

Three types of coloured areas can be chosen by the operator, they are the Red, Green and Blue areas. Each of these coloured areas are formed from a maximum of 10 subareas or regions whose coordinates are entered via the joystick device or the terminal keyboard.

The operator is asked to enter two file numbers. The file to be plotted on the X-axis is transferred to refresh buffer number 0 and the image to be plotted on the Y-axis is transferred to refresh buffer number 1. The operator is then asked if a correlation file is to be used. In the affirmative, the name of this file is requested.

A correlation file contains the coordinates of previously defined coloured areas used to produce an intensity correlation plot and saved at a previous session.

```
                *** CORRELATION INPUT ***

    X AXIS IMAGE

- Enter input  image no. (0 for exit) >
```

```
Y AXIS IMAGE

- Enter input  image no. (0 for exit) >

-Do you wish to use an old correlation  file (Y or N)  > _
```

A menu is then displayed and the operator must choose one of the six options:

```
        - - - INTENSITY CORRELATION MENU - - -

        - Edit Designated Area              (ED)
        - List Designated Area              (LS)
        - Perform Correlation Plot          (PL)
        - Output Designated Area            (OP)
        - Colour Menu Functions             (CM)
        - Return to MSA Menu                (RT)

        - Enter Two-Character Code  >     --
```

5.6.3.1 Edit Designated Areas (ED)

With the ED command the operator can select or deselect the regions of the three colour areas. This is normally the first command called in order to designate the target areas or regions

A submenu is displayed and the operator chooses one of the functions below.

```
        - - -     EDIT MENU     - - -

      - Toggle Input Device              (TD)
      - Insert a Red Region              (IR)
      - Insert a Green Region            (IG)
      - Insert Blue Region               (IB)
      - Delete Any Region                (DR)
      - Return to INCOR Menu             (RT)

      - Enter Two-Character Code        > __

        Current Input Device is JOYSTICK
```

5.6.3.1.1 Toggle Input Device (TD)

Two devices are used to input the coloured regions coordinates, the joystick (default) and the console keyboard. Each time this option is chosen the other alternate device is selected. The first time TD is used the message below the EDIT menu becomes:

Current Input Device is KEYBOARD

5.6.3.1.2 Insert a Coloured Region (IR,IG,IB)

Two X, Y values are entered by the operator via the input device. These coordinates define the diagonal corner points of a rectangle. The outline of this rectangle is drawn on the NORPAK display in the colour specified. A maximum of ten rectangles in each colour can be chosen.

INSERT REGIONS MODE

Colour selected is: RED

Select the 1st corner using the JOYSTICK

Select the 2nd corner using the JOYSTICK

To return to the edit menu a corner must be chosen with an X or Y coordinate outside the image boundaries, or after the selection of ten regions of one colour. In this last case, a message is sent to the console before returning to the EDIT menu.

Out of space on GREEN areas

Hit CR to continue

5.6.3.1.3 Delete Any Region (DR)

A pair of coordinates are entered via the input device by the operator. Any selected region that contains this point

will be deleted. If two region boundaries share pixels and one region is deleted, the common boundary line of the undeleted region will be erased from the display .

The console screen output after the deletion might look like this:

Rectangle(s) Deleted

XMIN	XMAX	YMIN	YMAX	COLOR
211	224	449	458	GREEN
207	228	453	459	GREEN

To return to the EDIT menu a point must be chosen that has an X or Y value outside the image boundary.

5.6.3.2 List Designated Area (LS)

When this option is chosen the operator is asked to choose the printer or the terminal screen to display the output. The X and Y coordinates and the colour of all chosen areas are then presented on the output device.

Listing device selection enter TT or LP > __

CORRELATION DEFINED AREA LISTING

RED				GREEN				BLUE			
XMIN	XMAX	YMIN	YMAX	XMIN	XMAX	YMIN	YMAX	XMIN	XMAX	YMIN	YMAX
154	170	444	446	197	210	446	459	126	138	370	379
166	174	420	445	224	237	455	460	317	337	426	436
145	156	424	434	236	242	457	459	379	401	426	435
176	184	436	451					405	416	419	423
158	162	427	438								
183	190	438	446								

5.6.3.3 Perform Correlation Plot (PL)

To save in processing time, the operator is asked if a limited processing area is to be selected. If no, the entire image is processed. In the former case, the operator must choose between joystick and keyboard as the input device to enter the coordinates of the two diagonal corners of a rectangle delimiting the region. Then the rectangle will be drawn on the NORPAK display and the operator will be asked to approve it.

```
    * * * CORRELATION PLOT * * *

Do you wish to select a limited processing area? (Y)es, or (N)o > _

Input device - JOYSTICK (CR) or KEYBOARD (KB)  > _

Corner one co-ords are  X =   n   Y =  n
Corner two co-ords are  X =   n   Y =  n

Approve input area ? ( CR or N ) > _
```

When a suitable area has been chosen the correlation plot is produced on the NORPAK video display.

5.6.3.4 Output Designated Area (OP)

This option transfers to disk the coordinates and the colours of the selected regions. The operator is asked to supply a file name for the output file. If the file exists, the operator has the choice of overwriting it or assigning it another name. If the file does not exist and can be created, the data is written and then the intensity correlation menu is displayed again.

```
              *** CORRELATION OUTPUT ***

 - Enter correlator output Filename ?
```

5.6.3.5 Colour Menu Functions (CM)

This command presents a submenu to the operator to help in the interpretation of the correlation plot scattergram. Any

of the four red, green, blue and grey colours can be turned on and off on the display monitor. The grey represents the background pixels ie the pixels of the processing area which are outside the coloured region.

```
- - -  CORRELATION COLOUR MENU - - -

- Toggle Red Selection              (TR)
- Toggle Green Selection            (TG)
- Toggle Blue Selection             (TB)
- Toggle Background Selection       (TD)
- Return to INCOR Menu              (RT)

- Enter Two-Character Code      >  --

  Current selection is: RED GREEN BLUE BACKGROUND
```

When an option is selected the chosen colour is turned off or on depending on its previous status.

5.6.4 Image Classification (CL)

The CL command calls for the Gaussian classifier program to classify one target of a multispectral image set (1 to 6). The algorithm scans the images pixel by pixel and rejects all pixels which by virtue of their multispectral signature have a low probability of belonging to the specified multidimentional spherical distribution, all other pixels are tagged or alarmed and are considered to be part of a specified class.

The threshold probability and specified distribution are entered by the operator when the signature and error vectors are requested. The result is a binary image stored in a refresh buffer and in a temporary disk file which can be saved at a later time into a standard image disk file. In the resulting image, the rejected pixels are displayed at an intensity zero and the alarmed pixels at mid intensity.

The operator is prompted for the following input data:

1. Number of image files: The number of input files to consider when doing the classification. Any number from 1 to 6 is valid input.

2. Target Signature: One intensity for each image file is expected. These intensities are the characteristic intensities of the target material in the band represented by the respective image file. Any integer from 0 to 255 is valid input.

3. Error Vector: One number between .01 and 255 is expected for each dimension (an image file is thought of as a dimension). It is the standard deviation associated with the corresponding signature component. This is used to normalize the metric space in which the distance between the target signature and the pixel signature is measured.

4. Confidence Level: One number between .01 and .99 is expected. The confidence level is the confidence that any given pixel belonging to the target will be identified.

Once the above parameters are entered the operator is asked to supply the image file number of each input image and the refresh buffer number where the resulting classification image will be stored. If a specified file cannot be found, the operator entry is erased and another attempt is made. If a file open error is encountered the operation is terminated and a message is sent to the line printer.

If while entering any of the above parameters a number is out of range, a file number not between 1 and 16 for example, an error message is written at the bottom of the console screen. The invalid entry is then erased and the query may be answered again.

Then the operator is prompted to visually check the input data and approve it.

```
        - - -  CLASSIFICATION INPUT - - -

Enter:      - Number of Image Files   (1-6)      > 2
            - Target Signature        (0-255)    > 100 130
            - Error Vector        (.01 - 255)    > 10 15
            - Confidence Level     (.01-.99)     > .8


 - Enter input  image no. (0 for exit) > 5
 - Enter input  image no. (0 for exit) > 6

 - Enter Refresh Buffer no. (0-3, NEG for none) > 0

 - Approve input ? ( (Y)es, (N)o, e(X)it ) > _
```

If approval is given, the classification operation starts and is indicated on the screen. If approval is not given all the input data are erased and must be reentered.

```
        <<<  CLASSIFICATION  IN  PROGRESS  >>>
```

When the classification is terminated, the operator has the choice to save or not save the classification result. In the affirmative case, he has to enter the image file number of the target disk file and a user comment for the file header and the LOG file entry in the manner described in a previous paragraph.

```
- Do you want to save result   -- (Y)es or (N)o ? > Y
- Then on which Image file no (1-16) > 7

---  OUTPUT file sequence no. is    n  ---

- Do you wish to enter a user comment (Y or N) > _
```

5.6.5 Colour Composite Image (CC)

With this selection the operator is asked to enter three image file numbers. As each image file number is input, if it is valid, the given image file is copied into a refresh buffer. (The first file is coloured red, the second green and the third blue). If a zero is entered as a file number the refresh buffer concerned is erased, no image is stored in it and therefore one solid colour image will be missing.

All the coloured images are displayed superimposed resulting in a multicoloured image.

5.6.6 Algebraic Combination of Images (AC)

The AC command allows the user to interactively define operators for multispectral reduction functions. A greater flexibility, reduced dependance and software support will result from this capability.

The user inputs a 'Fortran like' algebraic equation at the console keyboard to compute mathematical relations between images, pixel by pixel. This equation is checked for validity and proper syntax and converted into reverse polish notation for run-time assembly level compilation and execution.

The arithmetic operators **, *, /, +, -, (,) have their standard Fortran meaning and priority of execution.

Priority of operators

Operators	Function	Priority
(	left bracket	1
**	power	2
*,/	multiply/divide	3
+,-	additon/substraction	4
)	right bracket	5

Along with these operators integer and real constants may be used in the equation. The images are identified by their file number and the angle brackets as follow: < n > . An equation always starts with "< n > = " to specify which image disk file will receive the computed result in the alternative the operator decides to save it. If the destination disk file already exists, it will be deleted and replaced by the output result.

An example of an algebraic equation is shown below as entered at the keyboard:

```
- - --- ALGEBRAIC COMBINATION OF IMAGES --- - -

- Enter equation

  <4> = (3 * <2> + <1> ** 1.2)/(<1> - <2>)
```

After the equation is entered the user must approve it

```
- Is Equation Valid ? (Y)es,(N)o,e(X)it > _
```

If the equation syntax is correct, a Y answer starts the operation and a comment line is sent to the console to monitor the actual line number beeing processed.

```
Processing Image Data  Line:   n
```

However, if the syntax is at fault, one of the following error messages is sent at the bottom line of the console and the user has to try entering the equation again.

```
---   Mismatched Parenthesis   ---
---   Mismatched    < >  ---
---   Misplaced     .  ---
---   Invalid File Number    ---
```

```
---   Input Syntax Error   ---
---   Too Many   *  ---
---   Check Left Side of Equation   ---
---   Incorrect Number of   =  ---
```

This query must be answered in case of an equation input error.

```
Do you want to try again ? (Y)es,(N)o > _
```

The resulting image is stored in a temporary disk file and optionally stored in a refresh buffer for immediate viewing of the result.

At the end, the user can select to store the image in a standard disk image file. The following messages and queries guide the operator in the selection of the options.

```
- Enter Refresh Buffer no. (0-3, Neg for none) > _

- Do you want to save result   -- (Y)es or (N)o ? > Y

---  OUTPUT file sequence no. is     n  ---

 - Do you wish to enter a user comment (Y or N) > Y

 - Enter  1  or  2  lines of comment - 100 characters MAX

   You may enter more comments !
```

5.7 MONOSPECTRAL IMAGE ANALYSIS (SS)

5.7.1 Introduction

When this option is chosen the operator is given several choices via the menu below.

```
- - -     MONO  SPECTRAL      - - -
        IMAGE  ANALYSIS  MENU

- Load Image                          (LI)
- Histogram Equalization              (HE)
- Level Slicing                       (SL)
- Zooming                             (ZO)
- Pixel Intensity Dump                (DD)
- Return to Main Menu                 (RT)

- Enter Two-Character Code        >  __
```

These menu selections allow the operator to select an algorithm for the processing of a monospectral image. With this package, it is possible to contrast enhance an image using a histogram equalization technique, to colour slice an image by selecting a range of intensities for each colour, to zoom an image by an integer factor of 2 to 10, ie each pixel and each line are repeated n times on the display , and to dump on the line printer the pixel intensities of a portion of an image as well as some statistics about these pixel values. It is also possible to point and mark a pixel on the zoomed image and to view its intensity on the console.

The results of the selections are described in the following subsections.

5.7.2 Load Image (LI)

The function of the LI command is to query the operator for a specific image file to be loaded into refresh buffer 0. The Load Image operation must be performed prior to the execution of any other monospectral operations as these operations assume that an image is present in refresh buffer 0. However, if an image is already stored in buffer 0 it is not necessary to reload it. However with the Pixel Intensity Dump selection, any of the 4 refresh buffers can be used.

The screen query for this command is:

```
- Enter input  image no. (0 for exit) > _
```

5.7.3 Histogram Equalization (HE)

In order to improve the contrast of an image stored in refresh buffer 0, a histogram stretching technique is used to modify the intensities of the displayed pixels by way of a calibrated video table. This function allows the operator to view the histogram and the equalized histogram representing the frequency distribution of the pixel intensities of an image or of a part of it.

In the case where only a portion of the image is used to compute the histogram, only that portion (and any other portion with the same frequency distribution), is displayed contrast-enhanced. The transform computed to yield the equalized histogram from the regular histogram is applied to the original image through a video look up table to yield the equalized image.

The following queries and messages appear on the console screen during the execution of this function.

```
- - -  HISTOGRAM  EQUALIZATION  - - -

Do you wish to select a limited processing area ? (Y)es,(N)o > _
```

The joystick device is used to delimit a rectangular portion of the image for the computation of the histogram, and the coordinates are output.

```
Corner one co-ords are  X =  n   Y = n
Corner two co-ords are  X =  n   Y = n

Approve input area ? ( CR or N ) > _

      >>>  Computing              Histogram  <<<

      >>>  Computing  Equalized  Histogram  <<<
```

After the two histograms are traced on the TV monitor on a cyan colour background, a submenu is displayed on the console to enable the operator to visualize either the original image or the enhanced image or to view the histograms again.

```
- - -  HISTOGRAM  EQUALIZATION  MENU  - - -

 - Display Original  Image            (DO)
 - Display Equalized Image            (DE)
 - Display Histograms                 (DH)
 - Return to SSA menu                 (RT)

 - Enter Two-Character Code       >  __
```

.7.4 Level Slicing (SL)

The Level Slicing operation consists in colouring an mage according to its intensities. The range of pixel ntensities for each colour is specified by the user via the oystick device or the console keyboard using the histogram as a uide for the selection. Up to six colour slices may be chosen.

This operation assumes that the desired image has been oaded into refresh buffer 0 and also that its histogram has lready been computed via the HE operation immediately prior to he invocation of this function.

The colours for the slices are fixed and are described n the table below

No of slices ->	2	3	4	5	6	Colour
	1	1	1	1	1	Black
Slices			2	2	2	Blue
					3	Green
no's				3	4	Yellow
		2	3	4	5	Red
	2	3	4	5	6	White

For example, in the case of only two slices, the first olour is black and the second is white.

In order to help the operator in selecting the number of lice boundaries in pixel intensities, the operation starts by racing the histogram already computed by the HE command which s described in the previous subsection. The existence of this istogram is not compulsory. The level slicing can be done ithout it.

In any case, whatever the SL operation is given, one of he following messages appears on the console screen to specify he histogram status:

APPENDIX A

IMAGER ERROR MESSAGES

INTRODUCTION

The error and warning messages are sent to two different utput devices depending on the nature of the problem or ituation. Their destination is either the operator console or he line printer.

All messages involving a non-fatal operator error or ituation and warning messages are sent to the operator console, sually on the bottom line of the screen. They are later erased rom the screen after some corrective action is taken.

Other more serious problems caused by device and disk ile malfunction are sent to the line printer. Normally after a levice malfunction the operation is aborted and the previous menu s displayed on the console.

The format of these messages evolved with time, but eneraly the format for a console message consist of three mi-us igns (---) followed by the message in lower case charact-rs he first revision messages are all in upper case.

The messages sent to the line printer consist of the outine name, surrounded by stars (** NAME **), where the roblem originated followed by the message in upper case haracters.

MESSAGES AND EXPLANATION

--- BAND NO. n IS NOT ON TAPE

The operator is warned that he has chosen a band number hat does not exist on tape. A prompt is sent to the console sking the operator to input another band number (between 1 and 2) excluding the one previously chosen.

--- BOT ENCOUNTERED

The magnetic tape has skipped backward to the beginning, he tape is at LOAD point.

APPENDIX A

IMAGER ERROR MESSAGES

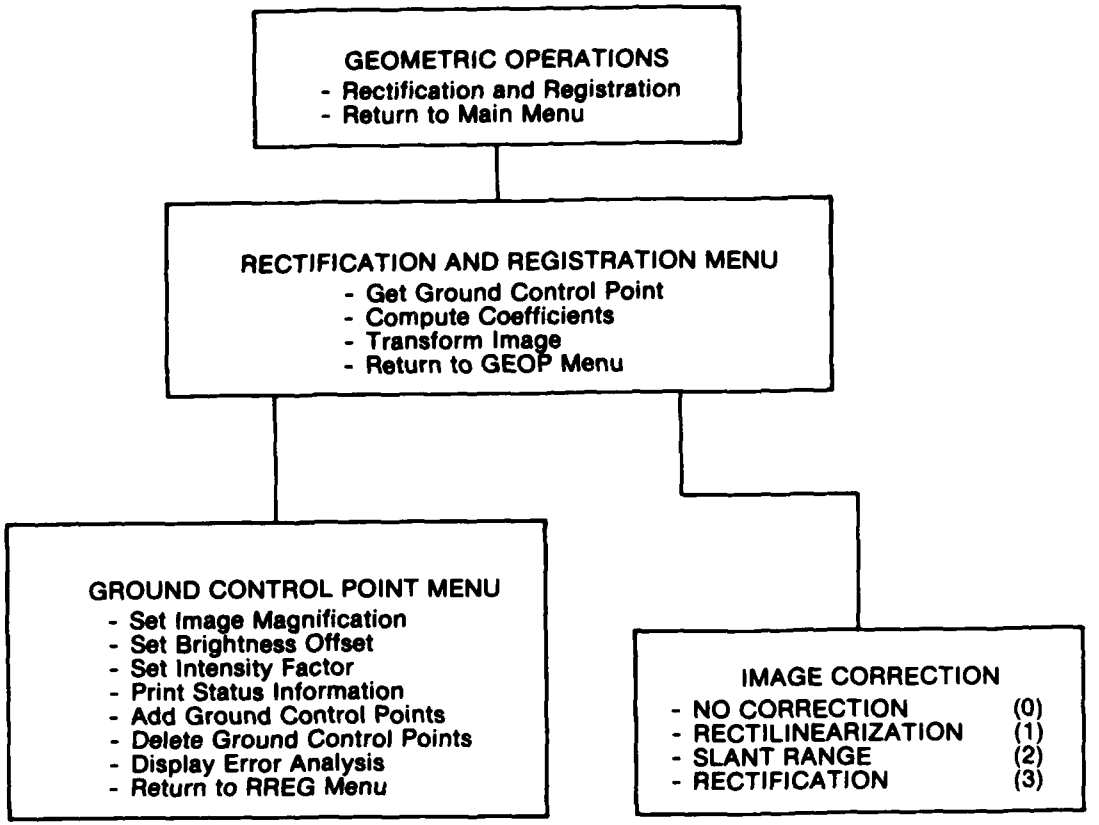


FIG. 5.6 GEOMETRIC OPERATIONS MENU STRUCTURE

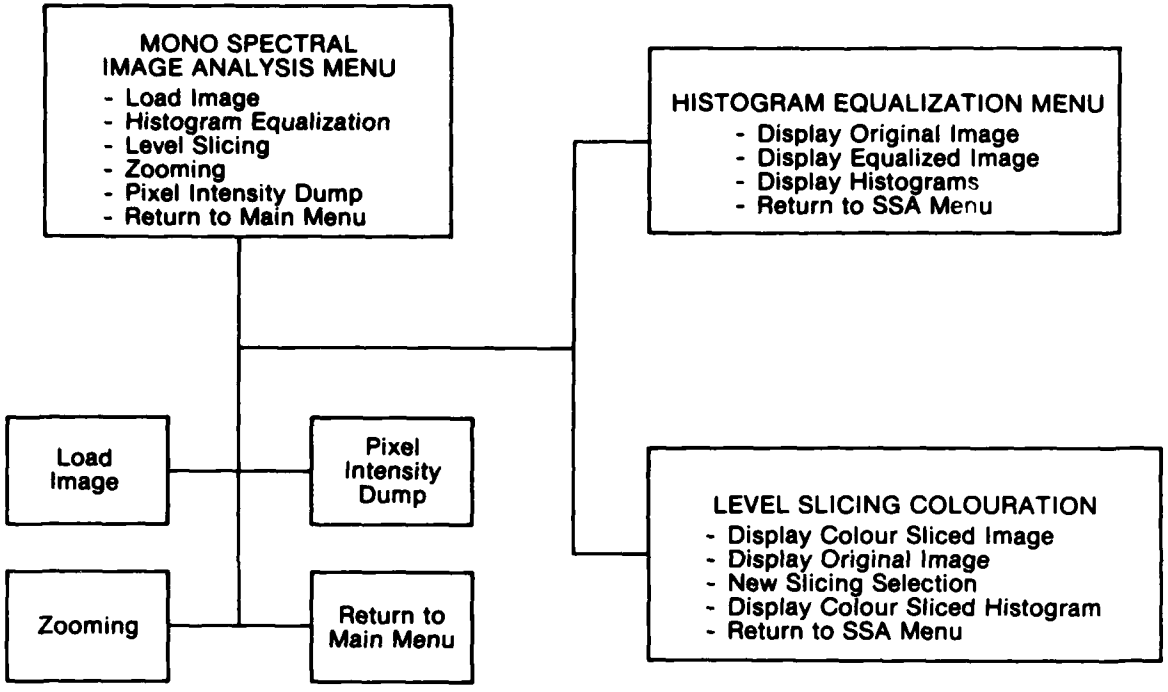


FIG. 5.5 MONOSPECTRAL ANALYSIS MENU STRUCTURE

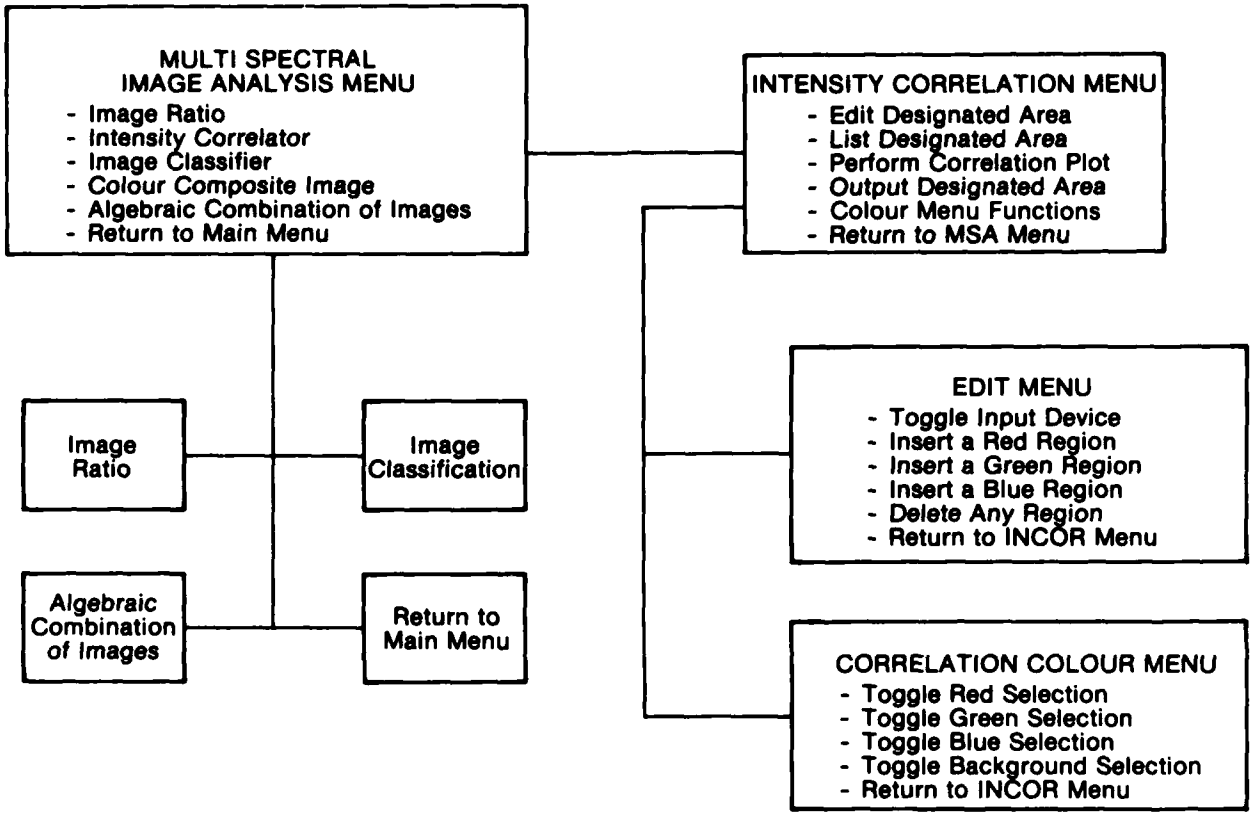


FIG. 5.4 MULTISPECTRAL ANALYSIS MENU STRUCTURE

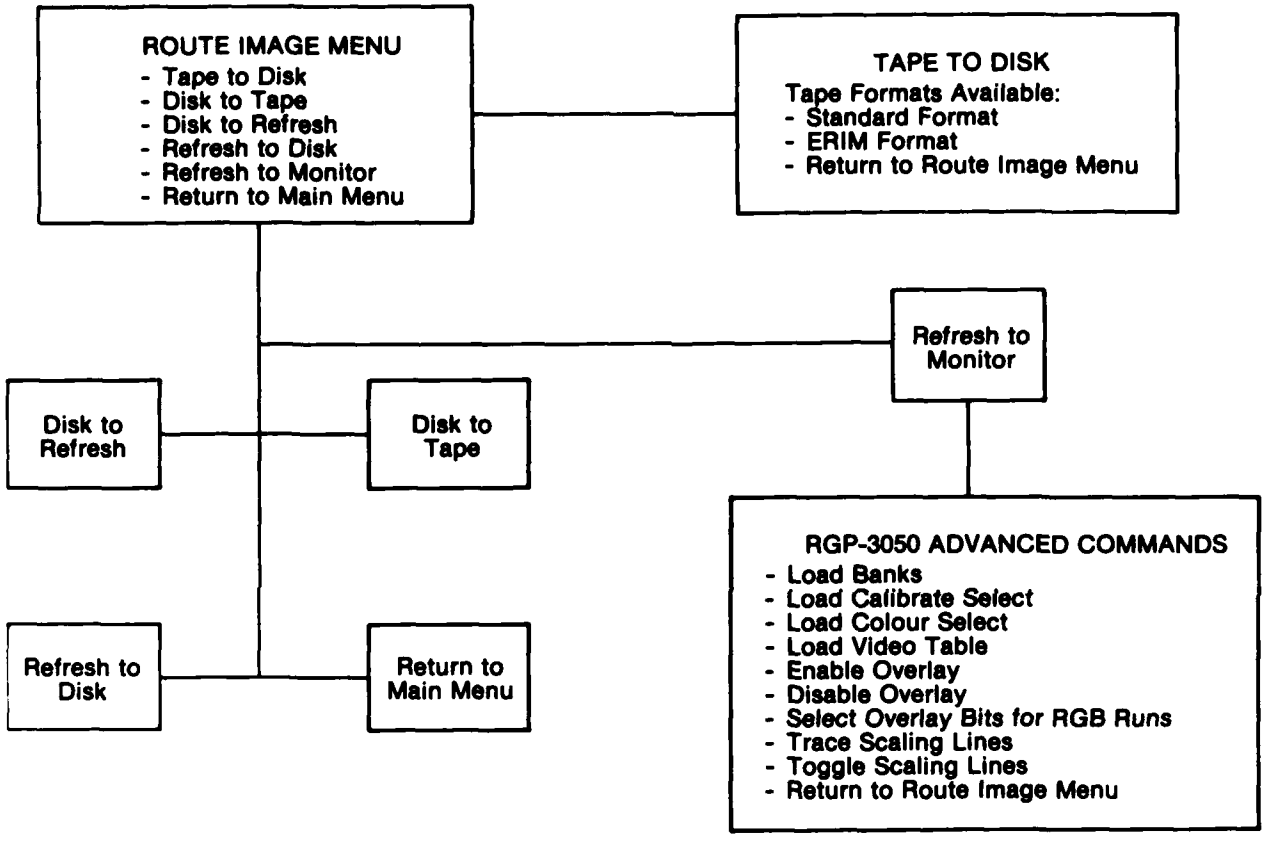


FIG. 5.3 ROUTE IMAGE MENU STRUCTURE

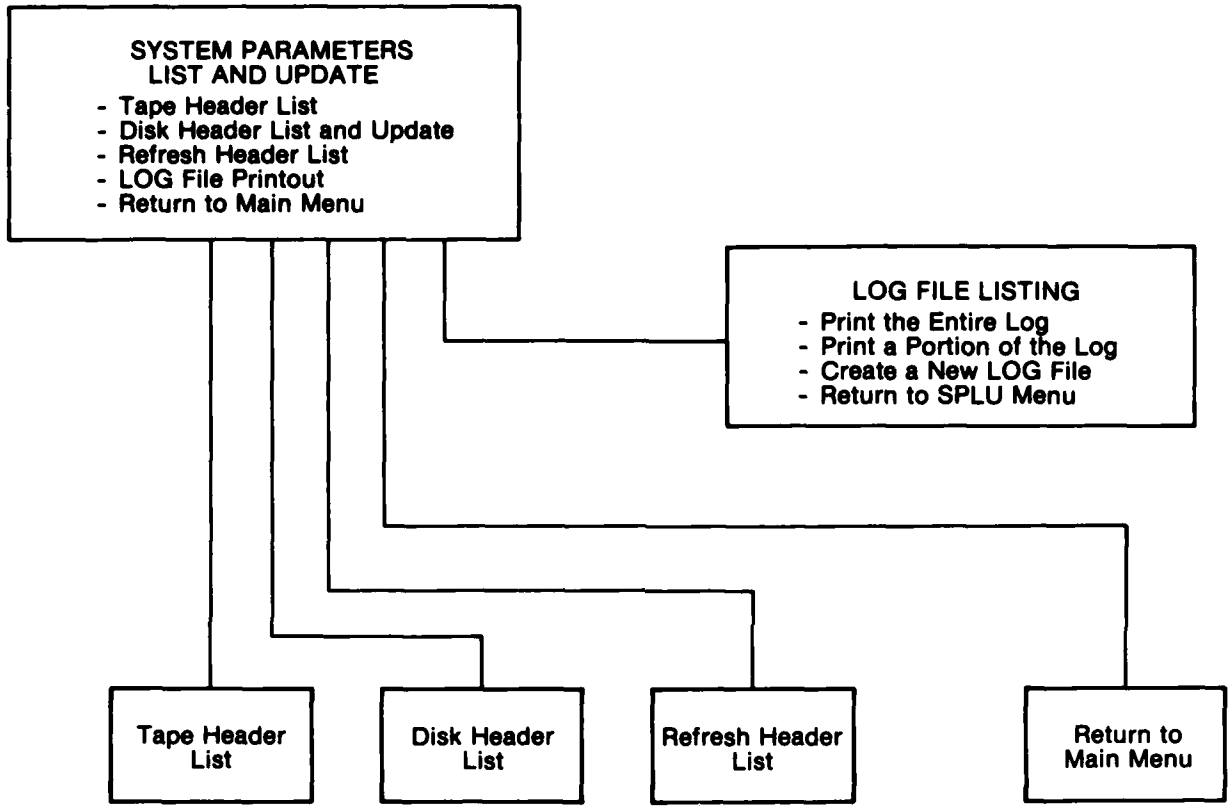


FIG. 5.2 SYSTEM PARAMETERS LIST AND UPDATE MENU STRUCTURE

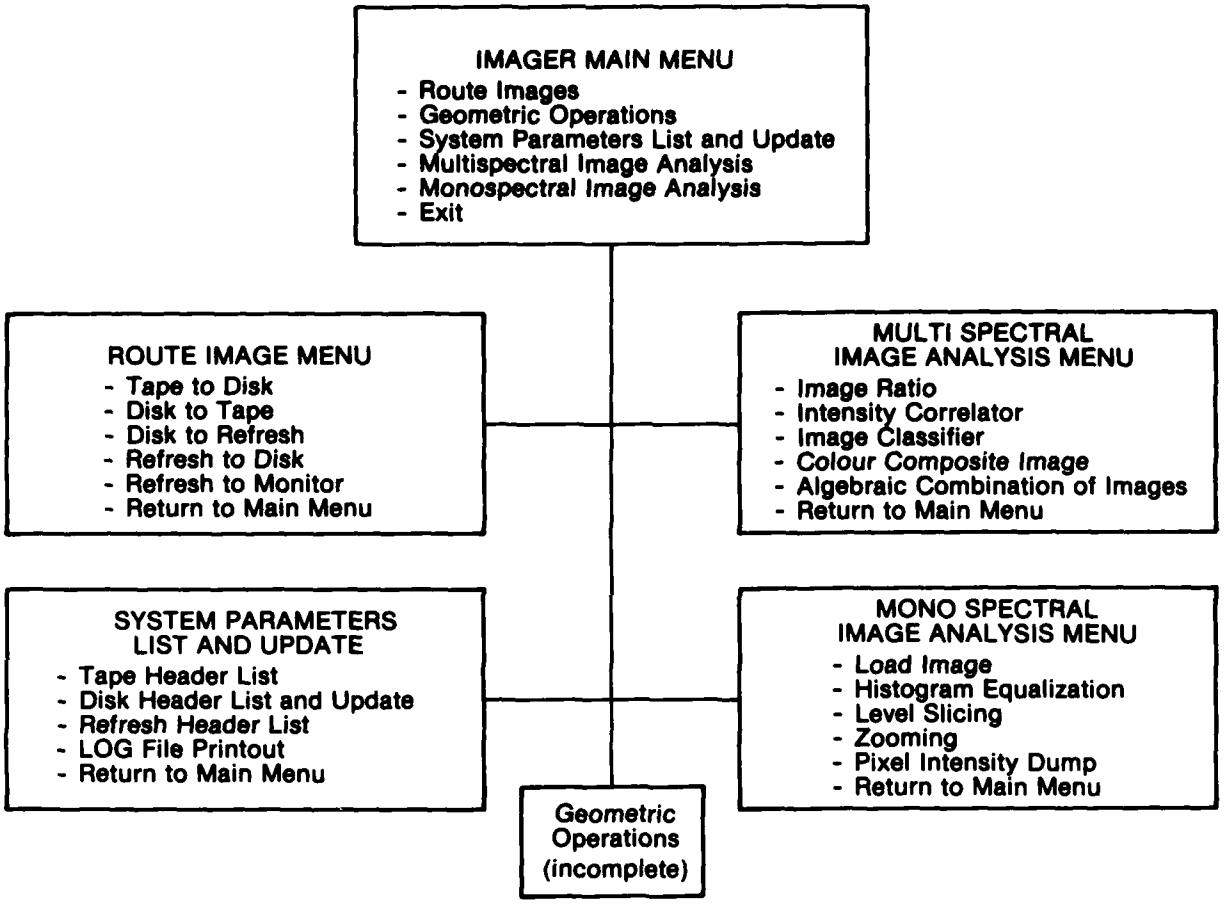


FIG. 5.1 IMAGER MENU STRUCTURE

PAGE 1

- - - IMAGE MEMORY DUMP - - -

BANK 0

PIXELS LINES	1	2	3	4	5	6	7	8	9
1	168	168	168	168	170	170	170	170	156
2	168	168	168	168	170	170	170	170	156
3	174	174	173	173	171	171	174	174	161
4	174	174	173	173	171	171	174	174	161
5	169	169	172	172	169	169	151	151	131
6	169	169	172	172	169	169	151	151	131

5.7.6.7 Print Header (PH)

With the PH command the header information of the image file displayed on the refresh buffer is printed on the line printer as well as on the console screen.

HEADER OF BANK 0

Sequence No. : 303 Date : 10/15/1981
Source Tape : CS10 Time : 13:51: 5

Comment : CS10 | LINES 1411-1652 | MAGNIFICATION 2 |
PIXEL 2500-2819 | BAND 11 | DAY | CRATER FIELD

If the image displayed does not come from a standard disk image file but by other means, the following message is sent when the PH command is given.

HEADER OF BANK n

--- Refresh Bank n Header non-existant ---

In the affirmative and if the input device is the keyboard, the region coordinates will be requested in the following manner:

```
For corner one   - Enter X & Y coordinates   1   1
For corner two   - Enter X & Y coordinates   9   6
```

and this prompt requests the usual approval of input data.

```
Approve input area ? (CR or N) > _
```

The following table is displayed on the console:

```
AREA:  Xmin     1     Xmax     9
       Ymin     1     Ymax     6
```

5.7.6.5 Mean and Standard deviation (ST)

With the ST command, the arithmetical mean and standard deviation of the intensities of the pixels enclosed inside the selected region of the displayed image are printed on the line printer as well as on the console screen.

```
Selected    /  Std-Deviation     19.090
Area       -|  Mean             159.917
Statistics  \  No of pixels          121
```

5.7.6.6 Print Pixel data (PD)

With the PD command, the intensities of the pixels enclosed inside the selected region of the displayed image are printed on the line printer.

The results of the selections are described in the following subsections.

5.7.6.2 Select a NEW Refresh Buffer (SB)

This command prompts the operator to enter a refresh buffer no. to be used for the pixel dump operation.

- Enter a Refresh Buffer no. (0-3) > _

The message below the menu, indicating the displayed refresh buffer, is always updated to reflect the answer to the above query.

5.7.6.3 Toggle Input Device (TD)

Two devices are used to input the coordinates of a region where the pixel intensities are to be dumped, they are the joystick (default) and the console keyboard. Each time this option is chosen the other alternate device is selected and the message below the menu is changed accordingly.

5.7.6.4 Select a Region (SR)

The SR command allows the operator to select a rectangular portion of an image to be used by the commands PD and ST to print their pixel intensities and their statistics. Once an area is selected, the pixel data of all the refresh buffers can be printed by an alternate use of the following commands SB, PD, ST in this specific order. It is also possible to print the pixel intensities of a full frame, but for an evident reason, it is not practical.

When the SR command is given, the following message prompts the operator to select either the full frame or only a smaller region or area for pixel intensity dump.

Do you wish to select a limited processing area? (Y)es or (N)o >

A table heading appears at the top of console screen and pixel addresses, intensities as well as sequence numbers are displayed each time the joystick button is pressed.

Iteration	LINE	PIXEL	Intensity
1	125	80	93
2	126	81	97
.	.	.	.

5.7.6 Pixel Intensity Dump (DD)

5.7.6.1 Introduction

The principal function of the Pixel Intensity Dump operation is to allow the operator to examine the pixel intensities of an image file from any of the 4 refresh buffers. These pixel intensities are printed on the line printer.

It is also possible to compute the mean and standard deviation of the selected pixels and to print the file header information on the console and on the line printer. For pixel information and calculations, the operator can specify a portion of the image of interest which will be the target area. In addition, he can toggle the input device to enable either joystick or keyboard input of the selected region.

When the DD option is chosen, the operator is given several choices via the menu below.

```
        - - -  IMAGE  MEMORY  DUMP  - - -

     - Select a New Refresh Buffer        (SB)
     - Toggle Input Device                (TD)
     - Select a Region                    (SR)
     - Mean and Standard Deviation        (ST)
     - Print Pixel Data                   (PD)
     - Print Header Data                  (PH)
     - Return to SSA Menu                 (RT)

     - Enter Two-Character Code       >  __

Displaying  BANK    0  ---  Input Device  JOYSTICK
```

The default refresh buffer to be operated upon is buffer 0 and the default input device to select the region or area of interest in an image frame is the joystick.

The magnified image is adjusted to fill the entire refresh buffer frame of 640 x 480 displayed pixels. The top left corner pixel address is printed on line printer for information. The magnification factor, between 2 and 10, means that a pixel and a line are repeated that number of times on the TV monitor to create the Zoom effect. With a factor of 10 a subimage of 64 pixels by 48 lines will fill the full screen.

The following messages and prompts are sent to the operator during the zooming operation.

```
        - - -  ZOOM  - - -

- Please enter magnification factor (2 - 10) > _

- X,Y selection via keyboard (KB) or joystick (CR)  ? > __

        Magnification of                n
        Pixel ordinate for zoom         n
        Line  ordinate for zoom         n

        Upper left coordinates of Magnified Image

        Line =    n  ---  Pixel =    n
```

After the zoomed image has been stored in the refresh buffer 1, the cursor appears on the TV monitor and the user, via the joystick device, can interrogate the system to get the pixel address and pixel intensity where the cross cursor points. These values are printed on the console screen and a small red cross with a sequence number are overlaid on the zoomed image for reference.

If the cursor is moved to the extreme right of monitor all the crosses are erased and the operator can continue to get pixel intensities. Alternatively, if the cross cursor is moved to the top, the operation terminates and the program returns to monospectral menu level

The following message appears for a few seconds on the console screen to guide the user in getting the pixel intensities.

```
    - - -  ZOOMED IMAGE  PIXEL INTENSITIES  - - -


- Using Joystick, pick points of interest

  Send  Cursor  outside at the   TOP     to  EXIT
  Send  Cursor  outside at the  RIGHT    to  ERASE the crosses
```

>>> Getting Histogram <<<

or

>>> WARNING: no Histogram available <<<

The user is asked to specify the number of slices and which input device he wishes to use to enter the slice boundaries.

```
- - -  SLICE  SELECTION  - - -

 - Enter no of slices (2-6) > _

 - Select input device  JOYSTICK  (CR)  or KEYBOARD  (KB) > _

 - Select FIRST  Slice      n
 - Select SECOND Slice      n
 - Select THIRD  Slice      n

          etc.
```

The histogram becomes colour sliced to show the relation between intensities and colour. A submenu is then displayed on the console so the operator can visualize either the original image or the colour sliced image, view again the sliced histogram or simply change to a new slicing selection.

```
- - -  LEVEL  SLICING  COLORATION  - - -

  - Display Colour Sliced Image      (DS)
  - Display Original Image           (DO)
  - New Slicing Selection            (SL)
  - Display Colour Sliced Histogram  (DH)
  - Return to SSA Menu               (RT)

  - Enter Two-Character Code       > __
```

5.7.5 Zooming (ZO)

This option permits the operator to view in the refresh buffer 1 a magnified portion of an image stored in the refresh buffer 0. The operator is prompted to enter a magnification factor and the center coordinates about which magnification is to occur. He must also specified the input device used to enter these coordinates ie the joystick device or the console keyboard.

** CORIN ** DISK ERROR n

Disk read error n in CORIN during read of correlation file.

** COROP ** DISK ERROR n

Error n occurred during write to disk in the COROP program.

--- DESTINATION DISK FILE NO. n IS ALREADY USED
--- DISK FILE NO. N IS ALREADY USED

The operator is warned that the file number chosen has already been used. A prompt is sent to the console screen asking to input another disk file number ranging from 1 to 16 inclusive and different from the one previously chosen.

--- DISK FILE n is WRITE PROTECTED.
DO YOU WISH TO OVERWRITE? (Y or N)

If the operator does not wish to overwrite the file n is input at this point and IMAGER will ask for a new destination disk file. If Y is entered IMAGER will carry on.

--- Disk file no. out of range

The operator is warned that a number outside the range from 1 to 16 inclusive has been used as a disk file number. A prompt is sent to the screen asking for a number in this range.

--- Disk file no. n does not exist

This message informs the operator that the disk file with the number n does not exist. A prompt is sent to the console asking the operator to input a source disk file number in the range from 1 to 16 inclusive and different from the one previously chosen.

** DKREF ** DISK ERROR NO n
WHILE PROCESSING IMAGE FILE n HEADER

Disc error during read or write of header in DKREF.

** DLIST ** DISK READ ERROR NO. n

This error occurred while the header of a disk file was being read. The operator will find an explanation of the runtime error corresponding to the given error number in Appendix B.

** DSQLN ** DISC READ ERROR n

Error n occurred during disk read.

** DSQLN ** EOF ENCOUNTERED ON DISC

End of file encountered during read of input file in DSQLN

--- END OF FILE ENCOUNTERED AFTER LINE n
WHILE READING DISK IMAGE FILE n

This message is sent to inform the operator that the image does not fill the entire file. As a result an end of file was encountered while the image file was being read. The operator is subsequently notified that the file transfer to the refresh bank has been completed.

** ERROR **
DUPLICATE DISK FILE NUMBERS
DISK FILES SELECTED ARE: n n

The operator has made the mistake of duplicating an existing disk file. Since IMAGER will not allow this, a prompt is sent to the console asking for a destination disk file number between 1 and 16, excluding the one previously chosen that was duplicated.

*** ERROR IN LINE n - TRANSFER NO. n

During tape to disk data transfer a tape read error will cause that line of imagery to be set to zero and the preceding error message is output. Any other tape errors or disk errors will cause the current disk to be deleted.

--- Error in opening correlation disk file

Error occurred during opening of correlation file. File not opened.

** FCHK ** DISK ERROR n

The error occurred as a result of an unsuccessful attempt at opening an existing disk file. The operator will find an explanation of the runtime error corresponding to the given error number in Appendix B.

--- Image disk file cannot be opened ---

An image disk file could not be opened. Probable cause is file not there or protected.

** IMAGE FILE NO n LINE n ZEROED
AS A RESULT OF DISK READ ERROR n

The line imagery being processed has been zeroed as a result of a disk read error.

Input error --- try again

Wrong type of data entered ie alpha instead of numeric.

** MTSER ** SYSTEM ERROR n ON MT OPERATION

This message informs the operator that a mag tape system error has occurred. The more frequently occurring errors such as beginning of tape, end of tape, and end of file errors are handled individually by other routines and as a result will not appear in this error message. The operator will find an explanation of the runtime error corresponding to the given error number in Appendix B.

*** NO INFORMATION ON TAPE ***

This message is sent to inform the operator that the tape mounted is a new tape and as a result has no information on it.

--- NO. OUT OF RANGE

This message is sent to the console to warn the operator that the input previously entered is not within the acceptable range.

** ODKRD ** DISK ERROR n DETECTED ON XXXX

This error occurred while attempting to open an existing disk file for reading. The operator will find an explanation of the runtime error corresponding to the given error number in Appendix B.

** ODKWT ** DISK ERROR n DETECTED ON XXXX

This error occurred while attempting to open a newly created or existing disk file for writing. The operator will find an explanation of the runtime error corresponding to the given error number in Appendix B.

--- OPERATOR INPUT ERROR
--- Operator input error
--- Operator Input Error --- Invalid input character
--- Operator Input Error --- Parameter out of range

The operator input was not what the program expected.

Out of space on AAAA areas Hit CR to continue

This message is displayed by the IREGI program. It means that ten regions of interest have been chosen in colour AAAA.

** RDERM ** DISK ERROR n

This error occurred while writing to a disk file or as a result of unsuccessfully trying to close a disk file. The operator will find an explanation of the runtime error corresponding to the given error number in Appendix B.

** RDERM ** PENDING DATA TRANSFERS ABORTED

This error is sent to inform the operator that all data transfers were aborted because of either a disk error or an unsuccessful opening of a disk file for the purpose of writing. If data transfers are aborted due to a disk error, the error number is sent to the line printer.

** RDKRF ** FILE TRANSFER ERROR
ALL PENDING DATA TRANSFERS ABORTED

This error occurred during the attempted execution of a file transfer. The error message preceding this one on the line printer will indicate whether the problem was encountered while opening a disk file for reading, opening a disk file for writing or reading an image file.

** RDKTP ** ERROR IN READING TAPE

This error message informs the operator that an error has occurred while the tape was being read. Possible problems

causing the above error statement are parity errors or end of file and end of tape errors.

** RDKTP ** ERROR IN SPACING TAPE

This message informs the operator that an error has occurred in spacing the tape. The possible causes of this error are the tape being positioned at the end of volume (EOV), end of tape (EOT), beginning of tape (BOT) or the occurrence of other tape errors.

** RDKTP ** ERROR n OPENING DISK FILE

This error occurred while trying to open a disk file for reading. The operator will find an explanation of the runtime error corresponding to the given error number in Appendix B.

** RDKTP ** ERROR n READING DISK

This error occurred while trying to read an open disk file. The operator will find an explanation of the runtime error corresponding to the given error number in Appendix B.

** RDKTP ** ERROR n WRITING TAPE

This error occurred while writing to tape. The operator will find an explanation of the runtime error corresponding to the given error number in Appendix B.

** RDKTP ** TAPE LABEL WRITE ERROR, IHWS = n
REINITIALIZE TAPE WITH RDOS

This error message is only for maintenance purposes. If it is encountered by the operator he should seek the help of the designers.

** RDKTP ** THIS TAPE IS NOT EXPENDABLE

This error occurred as the operator was trying to position the tape in order to write from disk to tape. The operator is unable to write to tape because either the tape was positioned unsuccessfully or there was an occurrence of a tape error.

** RDSTD ** DISK FILE OPEN ERROR FOR FILE n

This error occurred while trying to open a disk file for writing. The operator will find an explanation of the runtime error corresponding to the given error number in Appendix B.

** RDSTD ** DISK WRITE ERROR n

This error occurred while trying to write to an open disk file. The operator will find an explanation of the runtime error corresponding to the given error number in Appendix B.

** RDSTD ** ERROR GETTING TO TAPE FILE n
IF CAUSED BY AN EOF, THE TAPE FILE DOES NOT EXIST

This error occurred while trying to space forward or backward to the beginning of the desired tape file. The possible causes are the tape passing the end of tape mark, the tape being positioned at the end of volume (EOV) or any other tape error. If an EOF is encountered, the tape file does not exist.

** RDSTD ** ERROR READING TAPE HEADER
IF CAUSED BY AN EOF, THE TAPE FILE DOES NOT EXIST

This error occurred while trying to read the header from a tape file. The probable cause can be attributed to either hardware problems (data late or parity error) or tape errors (EOF or EOT). If an EOF is encountered, the tape file does not exist.

** RDSTD ** TAPE READ ERROR
TAPE FILE n LINE NO. n

This error occurred while trying to read the above specified tape file. The probable cause can be attributed to either hardware problems (data late or parity error) or tape errors (EOF or EOT).

** RDSTD ** WRONG TAPE FILE
SHOULD BE FILE n INSTEAD OF n

While reading the tape file header a check is made to see if this is the next tape file to be read. This error indicates that the present tape file number is n instead of the desired tape filenumber n.

** RDTP ** DATA LATE or PARITY ERROR - TAPE STATUS IS n

This error informs the operator that a tape error has occurred (ie. data late or parity error). The operator can determine the specific error by decoding the value returned by the tape status.

** RDTP ** EOF ENCOUNTERED - TAPE STATUS IS n

This error informs the operator that an end of file was encountered unexpectedly while reading tape.

** RDTP ** EOT ENCOUNTERED - TAPE STATUS IS n

This error informs the operator that an end of tape has been encountered unexpectedly while reading tape.

** RDTP ** TAPE ERROR - TAPE STATUS IS n

This error informs the operator that a tape error (other than EOT, EOF, PE or DL) has occurred. The operator can determine the specific error by decoding the value returned by the tape status.

--- Read error from terminal ---

A device error occurred during a read from the keyboard.

--- REFRESH BANK NON-EXISTENT

This message informs the operator that the refresh bank chosen does not exist. This warning is followed by an operator prompt which is sent to the console, asking for another refresh bank number in the range from 0 to 3 inclusive, which is different from the one previously chosen.

** REW ** TAPE ROUTINE ERROR - TAPE STATUS IS n

This message informs the operator that an error has occurred while rewinding the tape. The operator can determine the specific error by decoding the value returned by the tape status.

** RLIST ** DISK READ ERROR NO. n

This error occurred while refresh bank header was being read. The operator will find an explanation of the runtime error corresponding to the given error number in Appendix B.

** SEFB ** TAPE ROUTINE ERROR - TAPE STATUS IS n

This message informs the operator that an error has occurred while skipping backward over records. The operator can determine the specific error by decoding the value returned in the tape status.

** SEFF ** EOT ENCOUNTERED

This error message informs the operator that the end of tape was encountered while skipping forward over records.

** SEFF ** TAPE ROUTINE ERROR - TAPE STATUS IS n

This message informs the operator that a tape error (other than EOT) was encountered while skipping forward over records. The operator can determine the specific error by decoding the value returned by the tape status.

*** SPFIL - DOUBLE EOF ENCOUNTERED ***

When a double tape mark or end of volume (EOV) is encountered the tape is backspaced to before the double end of file (EOF).

** SPREC ** EOF ENCOUNTERED

This error message informs the operator that an end of file was encountered while spacing records forward.

** SPREC ** EOT ENCOUNTERED

This error message informs the operator that an end of tape was encountered while spacing records forward.

** SPREC ** TAPE AT BOT

This error message informs the operator that the beginning of tape was encountered while spacing records backward.

** SPREC ** TAPE ROUTINE ERROR - TAPE STATUS IS n

This message informs the operator that a tape error (other than EOF, EOT and BOT) has occurred. The operator can determine the specific error by decoding the value returned the tape status.

--- Tape file no. out of range

The operator is warned that a number less than 1 or greater than 100 has been used as input for a tape file number. A prompt is then sent to the console screen asking for a new tape file number.

*** TAPE HAS NO WRITE RING ***

This error message is sent to inform the operator that no writing will be done to tape until the tape has a write ring installed.

*** TAPE IS NOT STANDARD FORMAT ***

This error message is sent to inform the operator that the tape is not a standard format tape. (A standard format tape has a header that is 7 words long:

words 1 to 4 -> "STD.XXXX"
words 5 to 7 -> Mo./Day/Yr.

where XXXX is the tape number.)

--- TAPE NO. NOT MATCHED - MOUNTED TAPE IS n

The operator is warned that he has entered the wrong tape number. A prompt is then sent to the console asking the operator to enter another tape number.

** TPINI ** MAG TAPE ERROR n

This error occurred during the initialization and/or opening of the mag tape unit. The operator will find an explanation of the runtime error corresponding to the given error number in Appendix B.

** TPMNT ** TOO MANY TRIES IN MOUNTING TAPE
TAPE STATUS IS n OCTAL, IER = n

The operator was warned three times that IMAGER was unable to mount the tape. This message is sent to the line printer after the fourth unsuccessful mounting of the tape. The operator will find an explanation of the error in Appendix B.

--- UNABLE TO MOUNT TAPE!!

This message is sent to warn the operator that the system is unable to mount the tape. The operator should check to see that a tape is mounted and at load point and that the system is on-line. The operator should also check for the presence of bad tape.

** WEOF ** TAPE ROUTINE ERROR - TAPE STATUS IS n

This message is sent to inform the operator that a tape error has occurred while two EOF's. The operator can determine the specific error by decoding the value returned by the tape status.

*** WITH - SPFIL - BACKWARD ***

This message is sent to inform the operator that the previously written error occurred while spacing files backward.

*** WITH - SPFIL - FORWARD ***

This message is sent to inform the operator that the previously written error occurred while spacing files forward.

** WTRF ** END OF FILE AFTER LINE n
WHILE READING FILE n

The operator is informed of the occurrence of an end of file which was encountered while reading.

The following error messages have been introduced for release 3 of IMAGER software but no explenatory comments are given.

--- Error in CALL IMGOP RC = n
--- Error in CALL DKREF ERCOD = n
--- Error in CALL DKREF ERCOD = n
*** ERROR IN LINE n TRANSFER NO n
--- Invalid Input Character

--- File protected -- overwrite (CR or N)? > _

--- Number out of range! ---
--- Operator Input Error ---
--- Operator input error no. n

```
---  OUTPUT file sequence no. is     n  ---
---  Parameter out of Range
---  Refresh Bank  n  Header non-existant
---  Wrong Input Device Selection

---  WRONG OPERATION no FOUND with
     SEQUENCE no:     n  at   SEQUENCE no:     n

---   Check Left Side of Equation   ---
---   Incorrect Number of   =  ---
---   Input Syntax Error   ---
---   Invalid File Number   ---
---   Mismatched Parenthesis   ---
---   Mismatched    < >  ---
---   Misplaced   .  ---
---   Too Many   *  ---

** ALGCOMB **  EOF DURING IMAGE FILE < n>  READ
** ALGCOMB **  ERROR NO.     n DURING PARENT IMAGE ...
                                ... FILE < n>  READ
** ALGCOMB **  ERROR NO.     n DURING OUTPUT IMAGE ...
                                ... FILE <$ALGC>  WRITE
** ALGCOMB **  ERROR NO.     n WHILE PROCESSING IMAGE ...
                                ... FILE < n> HEADER
** ALGCOMB **  ERROR NO.     n WHILE PROCESSING IMAGE ...
                                ... FILE <$ALGC>
** ALGCOMB **  ERROR NO.     n WHILE PROCESSING OUTPUT ...
                                ... IMAGE FILE < n>

** CLASS **  ERROR NO     n  WHILE PROCESSING IMAGE ...
                              ...  FILE  n  HEADER
** CLASS **  ERROR NO     n  WHILE PROCESSING OUTPUT ...
                                 ... IMAGE FILE  n

** CLIMG **  ERROR     n  WHILE PROCESSING OUTPUT IMAGE  ...
                                ... FILE <$CLASS>
** CLIMG **  ERROR     n  WHILE WRITING TO OUTPUT  ...
                                ... FILE <$CLASS>

** COLCO **  ERROR IN CALL TO  DKREF ERCOD =  n

** COMPILE **  BAD  OR  TOO MANY IMAGE FILES
** COMPILE **  REAL    CONSTANT BUFFER OVERFLOW
** COMPILE **  INTEGER CONSTANT BUFFER OVERFLOW
** COMPILE **  ASSEMBLY PROGRAM BUFFER OVERFLOW
** COMPILE **  RUN TIME STACK ERROR
** COMPILE **  SYNTAX ERROR

** COPH **  OUTPUT HEADER CREATION OPERATION ABORTED
** COPH **  ERROR NO.     n  WHILE WRITING OUTPUT HEADER
** COPH **  ERROR NO.     n  WHILE GETTING SEQUENCE NO. OF ...
                              ... PARENT FILE   n
** COPH **  ERROR NO.     n  WHILE OPENNING LOG FILE
```

```
** COPH **  ERROR NO.      n  WHILE WRITING TO LOG FILE AT ...
                                  ... RECORD NO      n

** COROP **  DISK ERROR

** DKREF **     DISK ERROR  NO      n
               WHILE  PROCESSING  IMAGE  FILE   n  HEADER

** DLIST **  ERROR      n  IN WRITING HEADER TO DISK

** IMAGER **  ERROR      n  WHILE OPENING IMAGER:IMAGER.ER

** IMGOP **  IMAGE FILE NUMBER OUT OF RANGE       n
** IMGOP **  UNABLE TO OPEN IMAGE FILE < n>

** LOGLS **  ERROR      n  WHILE READING LOG FILE
** LOGLS **  OPEN ERROR      n
** LOGLS **  ERROR      n  WHILE READING LOG HEADER
** LOGLS **  ERROR      n  WHILE WRITING LOG HEADER

      MUST SEE ANALIST TO RECREATE IMAGER.LO

         ************************************
         *                                  *
         *  YOU  MUST STOP  THIS SESSION    *
         *                                  *
         ************************************
         *                                  *
         *              NOW                 *
         *                                  *
         ************************************

** MENU **    ERROR      n  WITH OVERLAY

** MSA **    ERROR      n  WITH OVERLAY

** MSG **  END OF FILE ENCOUNTERED
** MSG **  READ ERROR      n  ON DISK

** PHEAD **    DISK READ ERROR NO.      n

** RATIO **  ERROR      n  WHILE READING NUMERATOR   IMAGE FILE
** RATIO **  ERROR      n  WHILE READING DENOMINATOR IMAGE FILE

** RDERM **  ERROR AT TRANSFER no   n
** RDERM **  ERROR No      n  WHILE WRITING TO LOG FILE  ...
                                  ...  AT TRANSFER No  n
** RDERM **  LOG FILE OPEN ERROR No      n

** RB0LD **  ERROR IN CALL TO  DKREF  ERCOD =  n
** RB0LD **  ERROR IN CALL TO  IMGOP  RC =  n

** RPOLISH **  SYNTAX ERROR
** RPOLISH **  STACK OVERFLOW
```

```
** RPOLISH **  STACK UNDERFLOW
** RPOLISH **  DECODE ERROR

** RRFDK **  ERROR NO.     n  WHILE OPENING LOG FILE
** RRFDK **  ERROR NO.     n  WHILE WRITING HEADER
** RRFDK **  ERROR NO.     n  WHILE WRITING LOG ENTRY
** RRFDK **  ERROR NO.     n  WHILE WRITING LINE     n  to  DISK

** SEQNO **  OPEN ERROR No.  n
** SEQNO **  I/O ERROR No.     n

** THRES **  INTEGRAL ITERATED  10,000
             INTEGRATION ABORTED AT VALUE  n
```

The following error messages are for the Geometric Operations package. They are not yet implemented in the actual revision.

** ADDGCP ** DISK READ ERROR NO. n

This error occurred while the ground control point (.GC) file was being read. The operator will find an explanation of the runtime error corresponding to the given error number in Appendix B.

** ADDGCP ** DISK WRITE, ERROR NO. n
WHILE WRITING THE GCP's

This error occurred while the ground control points were being written to the .GC file. The operator will find an explanation of the runtime error corresponding to the given error number in Appendix B.

** ADDGCP ** KBIN TASK ERROR NO. n

This error occurred while the task KBIN was reading operator keyboard input. The operator will find an explanation of the runtime error corresponding to the given error number in Appendix B.

** AFFIN ** INSUFFICIENT DATA

The coefficients have not been computed because the operator has failed to choose at least four pairs of ground control points. Return to the Rectification and Registration Menu and subsequently add the required number of ground control points to the previously chosen file.

--- Brightness Offset value out of range

The operator is warned that he has input a number which is less than -255 or greater than +255. A prompt is then sent to the console screen asking the operator to input two brightness offset values between -255 and +255.

** CCOEF ** A .XF FILE ALREADY EXISTS

The operator is informed if a transformation file of the same name already exists. If this is the case, the coefficients have already been computed and the image transformation has been started or completed.

** CCOEF ** DISK READ ERROR n
WHILE READING THE .GC FILE

This error occurred while the ground control point (.GC) file was being read. The operator will find an explanation of the runtime error corresponding to the given error number in Appendix B.

** CCOEF ** DISK WRITE ERROR n
WHILE WRITING TO THE .GC FILE

This error occurred while the ground control points and the transformation coefficients were being written to the .GC file. The operator will find an explanation of the runtime error corresponding to the given error number in Appendix B.

** CCOEF ** NO COMPUTATION OF COEFFICIENTS

IMAGER has encountered a problem in opening a disk file. The above message will be preceded by a runtime error message sent by the runtime FCHK. The operator can check the error message by finding the appropriate error number in Appendix B.

** CCOEF ** XXXX .GC DOES NOT EXIST

The operator has chosen a non-existent ground control points file. He must either create a .GC file with this name or choose another .GC file that exists.

--- Coordinate out of range

The operator has input two coordinates to choose a ground control point. The above warning is sent to the console

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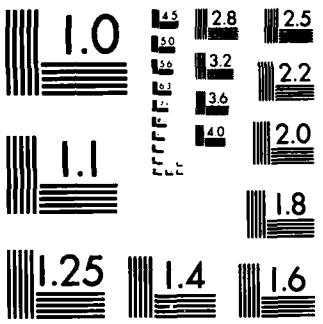
UNCLASSIFIED DREO-TN-82-16 F/G 20/6 NL

END

FILMED

DTIC



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if either the first number is less than 1 or greater than 640, or the second number is less than 1 or greater than 480. A prompt is sent to the console asking the operator to input the coordinates again. (NOTE: If the operator is asked for the reference coordinates, he can exit from this runtime by typing in a number less than or equal to 0 as the first coordinate).

** COPH ** INCORRECT OPERATION CODE

This message is sent to the line printer informing the operator that the operation being performed (eg. Rectification and Registration) is different from the operation code.

** COPH ** NO SPACE AVAILABLE IN OUTPUT HEADER

This message is sent to the line printer if the output file header is totally filled and no space is available to write in the array containing the operating description.

** COPH ** OPERATION DESCRIPTION IS TOO LONG

This message notifies the operator that the space available in the output file header is not large enough for the complete operation description to be added to it.

** DELGCP ** DISK READ ERROR NO. n

This error occurred while the ground control point (.GC) file was being read. The operator will find an explanation of the runtime error corresponding to the given error number in Appendix B.

** DELGCP ** DISK WRITE ERROR NO. n

This error occurred while the ground control points were being written to the .GC file. The operator will find an explanation of the runtime error corresponding to the given error number in Appendix B.

** DSKFIL ** DISK ERROR n READING REF FILE ...
... NO. n HEADERS

This error occurred while the reference file header was being read from the .GC file. The operator will find an explanation of the runtime error corresponding to the given error number in Appendix B.

** DSKFIL ** DISK ERROR n READING SRC FILE ...
... NO. n HEADERS

This error occurred while the registration data was being written to the .GC file. The operator will find an explanation of the runtime error corresponding to the given error number in Appendix B.

** DSKFIL ** DISK ERROR n WRITING TO XXXX

This error occurred while the registration data was being read from the .GC file. The operator will find an explanation of the runtime error corresponding to the given error number in Appendix B.

** DSKFIL ** REF FILE NO. n: HEADERS DO NOT MATCH

This error message is sent to the line printer to inform the operator that the header of the reference file is not the same as the reference file header contained in the ground control points (.GC) file.

** DSKFIL ** SRC FILE NO. n: HEADERS DO NOT MATCH

This error message is sent to the line printer to inform the operator that the header of the source file is not the same as the source file header contained in the ground control points (.GC) file.

** ERRAN ** ERROR ANALYSIS ABORTED
MUST HAVE AT LEAST n MORE GCP's TO PROCEED

This error occurred as a result of an insufficient number of ground control points. A minimum of four sets is needed to perform the error analysis and to compute the coefficients. In the above error message, "n" is calculated to be; n = 4 - the present number of GCP's.

--- GCP no. out of range

The operator is warned that he has input a number which is greater than the number of ground control points that exist in the .GC file. A prompt is sent to the console screen asking the operator to input a number, less than or equal to the total number of GCP's in the .GC file, as the number of the ground control point to be deleted.

** GOTXF ** DISK ERROR n

This error occurred while the transformation (.XF) file was being read. The operator will find an explanation of the runtime error corresponding to the given error number in Appendix B.

** GOTXF ** THE TWO FILE HEADERS ARE DIFFERENT

This error message is sent to the line printer to inform the operator that the header of the output file is not the same as the output file header contained in the transformation (.XF) file.

** HCHK ** DISK ERROR n

This error occurred while the header from a disk file was being read. The operator will find an explanation of the runtime error corresponding to the given error number in Appendix B.

** HCHK ** THE SOURCE FILE DOES NOT EXIST.

The routine HCHK checks a header to be verified with the original source header. The above message is sent to the line printer if the original source header does not exist.

** IMAGE HAS ALREADY BEEN TRANSFORMED

This message is sent to the line printer informing the operator that the image in question has already been transformed.

--- Intensity Factor out of range

The operator is warned that he has input a number which is less than 1 or greater than 10. A prompt is sent to the console screen asking the operator to input two intensity factor values between 1 and 10.

** LDIM ** DISK ERROR n ON DISK FILE NO. n
WHILE READING LINE n

This error occurred while an image file was being read. The operator will find an explanation of the runtime error corresponding to the given error number in Appendix B.

--- Magnification Factor out of range

The operator is warned that he has input a number which is less than 1 or greater 10. A prompt is then sent to the console screen asking the operator to input a number between 1 and 10 as the magnification factor.

** NOXF ** DISK ERROR n

This error is sent to the line printer from the routine responsible for the creation of a transformation (.XF) file. The error may have occurred while reading or writing the .GC, .XF or output files. The operator will find an explanation of the runtime error corresponding to the given error number in Appendix B.

** NOXF ** THE XXXX FILE DOES NOT EXIST

The above message informs the operator that there is no .GC file with this particular name. The routine NOXF is responsible for creating a transformation (.XF) file. A .XF file can only be created if a ground control points (.GC) file exists.

** PRSTAT ** DISK READ ERROR NO. n

This error occurred while the ground control point (.GC) file was being read. The operator will find an explanation of the runtime error corresponding to the given error number in Appendix B.

--- REF and SRC file numbers should be different

The operator has used the same file number for both the reference and source files. This warning tells the operator that the numbers should be different. A prompt is sent to the console screen asking the operator to input a source file number in the range from 1 to 16 inclusive and different from the reference file number.

--- REF Disk file no. n does not exist

This message informs the operator that the reference disk file with the number n does not exist. A prompt is sent to the console asking the operator to input a reference disk file number in the range from 1 to 16 inclusive and different from the one previously chosen.

** REFERENCE GCP MUST BE SELECTED FIRST **

This message is sent to the console screen if the operator attempts to choose a source GCP before a reference GCP from the magnified image. As stated, the reference GCP must be selected before the source GCP is selected.

** SAMP ** DISK ERROR n IN EXECUTION OF TASK KBIN

This error occurred while the task KBIN was reading operator keyboard input. The operator will find an explanation of the runtime error corresponding to the given error number in Appendix B.

** SAMP ** DISK ERROR n
WHILE READING RECORD n OF THE SOURCE FILE.

This error occurred while the source image was being read. The operator will find an explanation of the runtime error corresponding to the given error number in Appendix B.

** SAMP ** DISK ERROR n
WHILE READING THE .XF FILE.

This error occurred while reading the transformation coefficients and the image correction data from the transformation (.XF) file. The operator will find an explanation of the runtime error corresponding to the given error number in Appendix B.

** SAMP ** DISK ERROR n
WHILE WRITING RECORD n OF THE OUTPUT FILE.

This error occurred while writing a line of pixels to the output file. The operator will find an explanation of the runtime error corresponding to the given error number in Appendix B.

** SAMP ** DISK ERROR n
WHILE WRITING TO THE .XF FILE.

This error occurred while writing the next line for which to compute the transformation to the .XF file along with the coefficients and the image correction that was used. The operator will find an explanation of the runtime error corresponding to the given error number in Appendix B.

** SOURCE GCP MUST BE SELECTED NOW **

This message is sent to the console screen if the operator attempts to choose two successive reference GCP's. Once a reference GCP has been chosen, a source GCP must be chosen before proceeding further.

--- SRC DISK FILE NO. n DOES NOT EXIST

This message informs the operator that the source disk file with the number n does not exist. A prompt is sent to the console asking the operator to input a source disk file number in the range from 1 to 16 inclusive and different from the one previously chosen.

--- THE OUTPUT FILE AND SOURCE FILE CANNOT USE THE SAME FILE NUMBER

The operator has input an output file number equal to the source file number. IMAGER warns the operator that this is not acceptable and then proceeds to ask for another output file number in the range from 1 to 16 inclusive and different from the one previously chosen.

*** THE TRANSFORMATION COEFFICIENTS DO NOT EXIST ***

The operator is informed of the non-existence of the transformation coefficients (i.e. all coefficient are zero). The probable cause is that the operator has attempted to transform the image before computing the coefficients necessary for the transformation.

** TRY AGAIN - - GONE TOO FAR **

This message is sent to the console screen to inform the operator that the GCP chosen via the joystick is not on the visible portion of the image screen. He is asked to choose another GCP since he had gone too far for the previous one.

** XFIN ** DISK ERROR n

This error occurred while the transformation (.XF) file was being read. The operator will find an explanation of the runtime error corresponding to the given error number in Appendix B.

** XFIN ** THE TWO FILE HEADERS ARE DIFFERENT

This error message is sent to the line printer to inform the operator that the header of the source file is not the same as the source file header contained in the transformation (.XF) file.

APPENDIX B

FORTRAN 5 RUNTIME ERROR MESSAGES

APPENDIX B

FORTRAN 5 - RUNTIME ERROR CODES

SYSTEM ERRORS

```
ERFNO=    3          ;ILLEGAL CHANNEL NUMBER
ERFNM=    4          ;ILLEGAL FILE NAME
ERICM=    5          ;ILLEGAL SYSTEM COMMAND
ERICD=    6          ;ILLEGAL COMMAND FOR DEVICE
ERSV1=    7          ;NOT A SAVE FILE
ERWR0=    8          ;ATTEMPT TO WRITE AN EXISTENT FILE
EREOF=    9          ;END OF FILE
ERRPR=    10         ;FILE READ PROTECTED
ERWPR=    11         ;FILE WRITE PROTECTED
ERCRE=    12         ;FILE ALREADY EXISTS
ERDLE=    13         ;FILE DOES NOT EXIST
ERDE1=    14         ;PERMANENT FILE
ERCHA=    15         ;FILE ATTRIBUTE PROTECTED
ERFOP=    16         ;FILE NOT OPEN
ERFUE=    17         ;FATAL UTILITY ERROR
EREXQ=    18         ;EXECUTE CLI.CM (NO ERROR)
ERNUL=    19         ;INVISIBLE ERROR CODE
ERUFT=    20         ;CHANNEL ALREADY IN USE
ERLLI=    21         ;LINE TOO LONG
ERRTN=    22         ;ATTEMPT TO RESTORE A NON-EXISTENT IMAGE
ERPAR=    23         ;PARITY ERROR
ERCM3=    24         ;PUSH DEPTH EXCEEDED
ERMEM=    25         ;INSUFFICIENT MEMORY TO EXECUTE PROGRAM
ERSPC=    26         ;FILE SPACE EXHAUSTED
ERFIL=    27         ;FILE DATA ERROR
ERSEL=    28         ;UNIT IMPROPERLY SELECTED
ERADR=    29         ;NO STARTING ADDRESS
ERRD=     30         ;ATTEMPT TO READ INTO SYSTEM SPACE
ERDIO=    31         ;DIRECT I/O ACCESS ONLY
ERDIR=    32         ;FILES MUST EXIST IN THE SAME DIRECTORY
ERDNM=    33         ;DEVICE NOT IN SYSTEM
EROVN=    34         ;ILLEGAL OVERLAY NUMBER
EROVA=    35         ;NO DIRECT I/O
ERTIM=    36         ;INVALID TIME OR DATE
ERNOT=    37         ;OUT OF TCB'S
ERXMT=    38         ;SIGNAL TO BUSY ADDRESS
ERSQF=    39         ;SQUASH FILE ERROR
ERIBS=    40         ;DEVICE ALREADY IN SYSTEM
ERICB=    41         ;INSUFFICIENT CONTIGUOUS BLOCKS
ERSIM=    42         ;QTY ERROR
ERQTS=    43         ;ERROR IN USER TASK QUEUE TABLE
ERNMD=    44         ;NO MORE DCB'S
ERIDS=    45         ;ILLEGAL DIRECTORY NAME
ERDSN=    46         ;NO SUCH DIRECTORY
```

```
ERD2S=    47        ;DIRECTORY SIZE INSUFFICIENT
ERDDE=    48        ;DIRECTORY DEPTH EXCEEDED
ERDIU=    49        ;DIRECTORY IN USE
ERLDE=    50        ;LINK DEPTH EXCEEDED
ERFIU=    51        ;FILE IN USE
ERTID=    52        ;TASK ID ERROR
ERCMS=    53        ;COMMON SIZE ERROR
ERCUS=    54        ;COMMON USAGE ERROR
ERSCP=    55        ;FILE POSITION ERROR
ERDCH=    56        ;INSUFFICIENT ROOM IN DATA CHANNEL MAP
ERDNI=    57        ;DIRECTORY NOT INITIALIZED
ERNDD=    58        ;NO DEFAULT DEVICE
ERFGE=    59        ;FOREGROUND ALREADY RUNNING
ERMPT=    60        ;ILLEGAL PARTITION VALUE
EROPD=    61        ;DIRECTORY SHARED
ERUSZ=    62        ;NO ROOM FOR UFTS
ERMPR=    63        ;ADDRESS ERROR IN .SYST ARGUMENT
ERNLE=    64        ;NOT A LINK ENTRY
ERNTE=    65        ;CANNOT CHECKPOINT CURRENT BG
ERSDE=    66        ;SYS.DR ERROR
ERMDE=    67        ;MAP.DR ERROR
ERDTO=    68        ;DEVICE TIME OUT
ERENA=    69        ;LINK ACCESS NOT ALLOWED
ERMCA=    70        ;MCA REQUEST OUTSTANDING
ERSRR=    71        ;TRANSMISSION TERMINATED BY RECEIVER
ERSDL=    72        ;SYSTEM DEADLOCK
ERCLO=    73        ;CHANNEL CLOSED BY ANOTHER TASK
ERSFA=    74        ;SPOOL FILES ACTIVE
ERABT=    75        ;TASK NOT FOUND FOR ABORT
ERDOP=    76        ;DEVICE PREVIOUSLY OPENED
EROVF=    77        ;SYSTEM STACK OVERFLOW
ERNMC=    78        ;NO MCA RECEIVE REQUEST OUTSTANDING
ERNIR=    79        ;ATTEMPT TO RELEASE AN OPEN DEVICE
ERXMZ=    80        ;A ZERO .XMT OR .IXMT MESSAGE
ERCANT=   81        ;YOU CAN'T DO THAT
ERQOV=    82        ;TOVLD NOT LOADED FOR QUEUED OVERLAY TASKS
EROPM=    83        ;OPERATOR MESSAGES NOT SYSGENED
ERFMT=    84        ;DISK FORMAT ERROR
ERBAD=    85        ;INVALID BAD BLOCK TABLE
ERBSPC=   86        ;INSUFFICIENT SPACE IN BAD BLOCK POOL (CORE)
ERZCB=    87        ;ATTEMPT TO CREATE A ZERO LENGTH CONTIGUOUS FILE
ERNSE=    88        ;PROGRAM NOT SWAPPABLE
ERBLT=    89        ;BLANK TAPE


                        RUNTIME ERRORS


FESOV=    3076      ;STACK OVERFLOW
FEDAT=    3077      ;INSUFFICIENT ARGUMENTS FOR DATA INITIALIZATION
FESBS=    3078      ;SUBSCRIPT OUT OF BOUNDS
FEFMT=    3079      ;ILLEGAL FORMAT ITEM
FEINM=    3080      ;ILLEGAL INPUT NUMBER
FERCL=    3081      ;OUTPUT RECORD TOO LONG
```

```
'ERCS=    3082      ;INPUT RECORD TOO SHORT
'EIFN=    3083      ;ILLEGAL UNIT NUMBER
'EATT=    3084      ;INVALID OR INCONSISTENT FILE ATTRIBUTE
'ESEK=    3085      ;RECORD FILE REQUIRED FOR SEEK
'ESTK=    3086      ;ILLEGAL STACK SIZE
'EEVT=    3087      ;ILLEGAL EVENT USAGE
'ESQR=    3088      ;ILLEGAL ARGUMENT FOR SQRT
'EEXP=    3089      ;ILLEGAL ARGUMENT FOR EXP
'ELOG=    3090      ;ILLEGAL ARGUMENT FOR LOG
'EASC=    3091      ;ILLEGAL ARGUMENT FOR ASIN OR ACOS
'EATN=    3092      ;ILLEGAL ARGUMENT FOR ATAN2
'EPWR=    3093      ;ILLEGAL EXPONENTIATION
'EINT=    3094      ;INTEGER OVERFLOW ON CONVERSION
'ERTN=    3095      ;INVALID RETURN
'EFNU=    3096      ;UNIT NUMBER IN USE
'EMOP=    3097      ;ILLEGAL MODE FOR OPEN
'ERCR=    3098      ;RECORD COUNT REQUIRED FOR CONTIGUOUS FILE
                    ;CREATE-ON-OPEN
FEEOB=    3099      ;EXTENDED MEMORY REFERENCE OUT OF BOUNDS
FEW1K=    3100      ;WINDOW AGGREGATE DOES NOT BEGIN ON
                    ;1024-WORD BOUNDARY
FEBLN=    3101      ;ILLEGAL BLOCK NUMBER
FEBLC=    3102      ;ILLEGAL BLOCK COUNT
FENPC=    3103      ;NO FILE PRECONNECTED TO UNIT NUMBER
FERLN=    3104      ;ILLEGAL VALUE FOR RECORD LENGTH IN
                    ;LEN= SPECIFIER
FELEF=    3105      ;INCONSISTENT SPECIFICATION FOR LEF MODE
FEONO=    3106      ;OVERLAY FILE NOT OPEN
FEOAO=    3107      ;OVERLAY FILE ALREADY OPEN
FETID=    3108      ;ILLEGAL TASK IDENTIFIER
FEPRI=    3109      ;ILLEGAL TASK PRIORITY
FEEVN=    3110      ;ILLEGAL EVENT NUMBER
FEPNA=    3111      ;REQUESTED PARTITION NOT AVAILABLE
FERTC=    3113      ;NO REAL TIME CLOCK
FETMQ=    3114      ;TOO MANY QUEUE BLOCKS SPECIFIED
FEFPU=    3115      ;FLOATING POINT HARDWARE IS NOT PRESENT
FEMDV=    3116      ;MULTIPLY/DIVIDE HARDWARE IS NOT PRESENT
FEMEM=    3117      ;INSUFFICIENT MEMORY FOR FORTRAN 5 PROGRAM
FEIOP=    3118      ;DID NOT ALLOW FOR IOPROG IN IOPC CALL
FEPTO=    3119      ;PROGRAM TABLE OVERFLOW
FETTL=    3120      ;TIME INTERVAL TOO LARGE
FEIRN=    3121      ;ILLEGAL RECORD NUMBER
FEIFV=    3122      ;ILLEGAL FLAG VALUE
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13 ABSTRACT

The purpose of this document is to assist the user of the Dreo Image Processing System, in the processing of digital images. The system, which includes a minicomputer and a NORPAK Image Processor, is accessed via an easy-to-use menu structure. The manual explains the general purpose of the functions accessed through the menus as well as the subtleties of their uses.

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KEY WORDS

Digital Image Processing,
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